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## ORIGINAL MEMOIRS.

# RECENT ADVANCES IN PULMONARY SURGERY.*

WITH SPECIAL REFERENCE TO DIFFERENTIAL PRESSURE AND WOUNDS OF THE LUNG.

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THE great advances that have been made in pulmonary surgery within a short space of time are apparent to the most casual student. We have been interested in glancing over the contributions in this field to the Transactions of this Society in the last twelve years, and it seemed to us of interest to contrast our attitude ten or twelve years ago, and that which we assume to-day.

Take, for example, the report by Dr. R. N. Downs, Jr., in December, 1898, of a case of stab wound of the chest, operated by Le Conte, whose investigations and views on this subject are so well known and so respectfully quoted (except by some German authorities), and the discussion thereon participated in by the lamented Willard, who years before had pursued careful experimental studies in lung surgery. Le Conte and Willard had firm grasp of the physiological problems encountered, but alas, the modern appliances for solving them were then, with the exception of the Fell-O'Dwyer

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method, as yet unheard of, while the reaction of the pleura to infection and to pneumothorax was as yet unstudied, except on clinical grounds. Direct treatment of the bleeding lung was only mentioned as a last resort, and the introduction of a drainage tube and the establishment of lung collapse was a measure greatly in advance of any then in vogue. True it is that already at least two cases of lung suture were on record before 1898,—one by Omboni [1] in 1884 for gunshot wound, and one by Delorme [2] in 1893 for stab wound; but both patients had died, and they were as yet without imitators.

Da Costa's bold treatment of a case of secondary hemorrhage from the lung by thoracotomy and a huge tampon was looked upon, and rightly, with the experience then at our command, as an achievement demanding great surgical courage. Consider Stewart's report in April, 1900, of a pyopneumothorax associated with fracture of the ribs, and judging from the symptoms either a laceration or rupture of the lung, and a "tension pneumothorax." Repeated aspirations failed to relieve, and opening of the chest and the introduction of a rubber drainage tube were finally practised, and successfully. How would we then have considered Garre's recommendation that thoracotomy be practised without loss of time and the wound in the lung sought for and sutured? The ingenious Hopkins [3] had striven to devise valve systems of drainage for the air-containing and the infected pleura, but these were as yet Wills-of-the-wisp, or as Harte sarcastically remarked, "mechanical toys," and perhaps are little more to-day.

With the passing of time, however, we have learned some things and unlearned others; and at least two cases of suture of the wounded lung are now on record by Fellows of this Academy; although both, we remark with regret, are ignored by the patriotic German authorities (Jopson,[4] Kelly [5]).

But in this field, we would again emphasize, the advances have been so rapid that authorities are soon outworn, and the articles on chest surgery in our best and most recently published systems miss many of the most vital points of the subject.

It has seemed to us that in considering these revolutionary changes, they embrace from an operative stand-point those measures aimed at overcoming the symptoms, at times appalling and always to be borne in mind, which may attend pneumothorax and lung collapse; and secondly, those pertaining to operative technic, as modified by the nature and resistance to infection of the pleura and the thoracic contents.

We have undertaken a study of some recent literature on these general subjects, as well as on the special subject of the operative treatment of wounds of the chest.

A brief review of the physiological conditions found in the lungs and pleura in relationship to intrathoracic pressure as distinguished from intrapulmonic pressure may be useful and is necessary to a clear understanding of the problems involved in a study of methods of differential pressure. By intrathoracic pressure is meant the pressure in the thoracic cavity outside the lungs, and which is present in the unopened pleura and mediastinum. Intrapulmonic pressure is the pressure found in the air-passages and the alveoli. At the end of both inspiration and expiration the intrapulmonic pressure is equal to atmospheric pressure, as these passages are at this time in communication with the external air. During inspiration this pressure falls and becomes negative. The degree varies with the degree of constriction in the parts above, especially including, under normal conditions, the glottis. During expiration the pressure rises. Under normal conditions of quiet respiration these variations are not great—from 7 to 10 mm. of water as measured by the manometer. If the glottis be closed, the variations in pressure are greatly increased, and these variations have a marked effect upon the heart and circulation (Howell [6]).

Intrathoracic pressure, or that present in the pleura and mediastinum, is always negative under normal conditions; that is to say, it is always less than the atmosphere. The reason for this is, to quote Howell, that the lungs are smaller than the cavity which they occupy. "The lungs are distended to fill the thoracic cavity, and consequently the organs, like

the heart, which lie in this cavity outside the lungs are exposed to a pressure of one atmosphere, minus the force of elastic recoil of the lungs." Howell defines intrathoracic pressure, therefore, "as intrapulmonic pressure, minus the elastic pull of the lungs, and since under usual conditions the intrapulmonic pressure is equal to that of the atmosphere, the intrathoracic pressure is less than an atmosphere by an amount equal to the recoil of the lungs." This negative pressure is greater during inspiration than during expiration, being, according to Heynsius, equal to — 7.5 mm. of mercury at the end of inspiration, and to — 4.5 mm. of mercury at the end of expiration. If by opening the chest wall and parietal pleura this negative pressure is abolished, the entrance of air into that side of the chest is attended by collapse of the lung, and pneumothorax results on that side.

Space forbids any extensive inquiry into the causes of dyspnœa and collapse which may attend pneumothorax. That these symptoms are not always or even usually present in the human subject when only one side of the chest is opened is well known and long since emphasized by Matas, Trendelenburg, and many others; and many successful operations confirm the view that they may be absent or of but moderate gravity. A dog is killed by wide opening of one pleural cavity unless some form of differential pressure is employed. The thin and easily ruptured mediastinum is the animal's undoing. The rabbit can safely undergo the same operation without fear of collapse (Robinson and Leland[7]); and it has been well said by them that some human subjects have a dog's lungs, and some a rabbit's.

The margin of safety is not large enough to disregard the methods now at hand to guard against an alarming or fatal collapse; and to-day, in Germany at least, every large clinic has a positive pressure apparatus or a Sauerbruch chamber at its disposal (Wolf[8]); no less than 35 clinics being so equipped at the beginning of the year 1910 (Robinson[9]). In this country, Meyer, Green and Janeway, Robinson, Elsberg, Lilienthal, and others are equipped, and are doing

active clinical work. In plain words, haphazard surgery would seem to have reached its limit, and except in cases of emergency, the time is at hand when the surgeon doing thoracic work must equip himself accordingly.

A brief enumeration of the theories advanced in explanation of the dangerous symptoms of lung collapse is furnished by Wolfe;[8] Murphy and Garré seek the cause in an insufficient fixation of the mediastinal pleura, which flutters to and fro in respiration, hindering both inspiration and expiration, dyspnœa being more common than collapse in unilateral pneumothorax. Rehn attributes them to a displacement of the mediastinum to the opposite side, causing a kinking of the larger bronchi; while Friedrich sees the cause of collapse in circulatory disturbances due to kinking of the great vessels. If we add to these the view of Tiegel,[10] who believes that a deficiency of lung ventilation and of oxygen is the chief danger in pneumothorax, which deficiency might be explained by either of the first mentioned theories, it furnishes us with an explanation of the successful action of the several methods which have been adopted to prevent a collapse of the lung and to maintain respiration, and thus meet the complications of accidental and operative pneumothorax.

Under the head of differential pressure, we include the several methods of prevention of pneumothorax and collapse of the lung.

Differential pressure has been tersely defined by Willy Meyer as a higher pressure within the lungs than outside of them. As is well known, this is produced in one of two ways: either by increasing the intrapulmonic pressure—the positive pressure method; or by decreasing the atmospheric pressure on the surface of the lung—the negative pressure method.

Green and Janeway[11] divide the forms of apparatus for artificial respiration into four classes, and this classification will suit our purpose. They are, first, those providing either negative or positive pressure, as the operator desires, the cabinets of Sauerbruch and Meyer; second, the positive pressure cabinets of Brauer, Murphy, Janeway and Green; third, the

positive pressure masks of Robinson and Tiegel; and lastly, the devices for direct insufflation through the larynx or trachea, of Fell, O'Dwyer, Doyen, Matas, Green, Volhard, and Meltzer.

That there is not any essential difference between the results obtained by the positive and negative pressure is acknowledged by many of the experimenters in one or the other field. It would seem to be a case where indeed "The ways they are many. The end it is one."

While to Sauerbruch is due the credit for the tremendous impetus which his introduction of the negative pressure cabinet bearing his name gave to the study of the subject, and while it must not be forgotten that it was he also who pointed out that by a reversal of the position of the patient in his cabinet positive pressure could be produced, it would seem that the early pioneers in the field are to-day scarcely receiving the credit that is their due; and that we in this country at least should not forget that Fell, O'Dwyer, and Matas did yeoman's service in the introduction and development of what is as truly a positive pressure method as any of the forms of apparatus of which we hear so much to-day. A parent is naturally partial to his own child, and we find Fell [12] in a recent article again calling attention to the merits which his apparatus in its latest form possesses. In the earlier forms of negative and positive pressure cabinets the intrapulmonic pressure was static, and the respiratory movements were dependent upon the patient himself. While collapse of the lung was prevented, cessation of respiratory movements would quickly end fatally, and might easily result from paralysis of the respiratory centre, whether produced by poison or shock.

The ease with which Fell overcomes this danger by his method of forced respiration, varying at will the number of respirations from 5 to 50 per minute, following when desirable the autorespirations, and controlling the degree of collapse or inflation of the lung to suit the operator, makes him doubt the flexibility of the mechanism of the cabinets, or what Carrel calls the "classical" types of apparatus. But with the

improvements which have been already obtained in some of these wonderfully ingenious and (although it must be said cautiously to avoid Meyer's sharp criticism) complicated pieces of apparatus, rhythmic changes of pressure sufficient to aid the patient's flagging respiration and to effect exchange of the air in the lung by its alternate collapse and distention can be readily obtained.

To pass on from this reference to Fell's apparatus, which he has modified to meet the demands of both positive and negative pressure, to the consideration of the classical types of apparatus, the cabinets of Sauerbruch, Brauer and Peterson, and their followers, and the masks of Robinson and Tiegel, we find that the mechanical perfection of these forms of apparatus has made great progress since Sauerbruch's cabinet was presented in 1904. Meyer [13] and his brother have constructed a differential pressure cabinet which permits of the use of either positive or negative pressure, or a combination of the two, and which in the working out of details is the most perfect form of apparatus from a mechanical stand-point yet offered. Of course, the time required for knocking down and transporting such a piece of mechanism practically renders it available in only one institution. So, too, the positive pressure cabinet constructed under the supervision of Robinson [9] for the Massachusetts General Hospital, while less elaborate, and much less costly, is also open to this objection. But smaller and easily transportable devices are provided in the positive pressure cabinet of Green and Janeway, and the positive pressure masks of Robinson and Tiegel. The cabinet of Green and Janeway permits of a rhythmic rise and fall in the pressure of the inspired air and ether vapor, a true artificial respiration being carried on without any effort on the part of the patient, and it can be used for respiratory failure due to any cause. The inspired air is warmed, thus overcoming an objection which has been urged against positive pressure, and the ether vapor is diluted. The patient's head is under perfect control, and the positive pressure around the patient's head in the cabinet induces a degree of cerebral anæmia, which renders less ether necessary.

A more extensive description of these cabinets is superfluous, but the large cabinet of Robinson, where the etherizer sits in the cabinet, connected by megaphone with the outside world, administering the ether in the ordinary manner except for the fact that the pressure in the cabinet is elevated to 10, 15, or 20 mm. of mercury at will, the patient's air passages free and under perfect control and inspection, and the whole interior fed with air by noiseless motor and ventilating pumps, certainly appeals to the imagination at least, as a wholly practicable device.

The positive pressure masks are exemplified in Robinson's smaller apparatus and Tiegel's mask. The description of Tiegel's [14] apparatus and a citation of the results obtained by Tiegel in Henle's clinic [10] lead one to believe that the method he employs may yet be found the most practicable. The apparatus is comparatively simple. The mask is similar to that used in giving nitrous oxide, and can be quickly applied or removed. Tiegel finds that the use of oxygen instead of atmospheric air has certain advantages. It is not necessary to use the same amount of pressure as with air, 1 to 2 cm. of water being sufficient in most cases of unilateral pneumothorax, higher pressure being reserved for cases of tracheal stenosis, double pneumothorax, threatened aspiration of blood, and for fully distending the lung at the conclusion of the operation. The fact that the exposed lung is not fully distended under low pressure renders manipulation easier than in the Sauerbruch method, for example, where the lung is kept in contact with the chest wall. At the same time, while using oxygen, the breathing continues regular, and there is neither dyspnœa nor cyanosis. Distention of the stomach, which has occurred under the use of other forms of positive pressure, is avoided (he cites a fatal case of Küttner's). The pressure supplied from an ordinary oxygen cylinder takes the place of the pump with its complicated parts and liability to internal disorders. The fact that his apparatus has been freely tested, not only on animals but in pressure stenosis of the air-passages, and in stab wounds, rupture of the lung, and resection

of the chest wall, has proved its practical value. Experimental work on healthy dogs is, as Meyer says, different from operations on sick people, and he quotes Tiegel himself as reminding us that "dogs do not drink, smoke, or stay out late at night."

This brings us to the last of the four methods of obtaining differential pressure, viz., that of direct insufflation through the larynx and trachea. We have already alluded to the pioneer work of Fell, O'Dwyer, and Matas in this field. Kuhn of Cassel, with his peroral intubation method; Dorrance, with his intratracheal pressure bulb tube, used in combination with the Matas clinical respiratory apparatus; Volhard and Robinson, have all contributed something to this method, and in a measure paved the way for the reception of the method of Meltzer and Auer,[15] which comes to us with the stamp of approval of Carrel, and has been tested on the human subject by Elsberg and Lilienthal. It is based on the following facts: The exchange of gases in the lung is maintained by a system of ventilation. Internal respiration is the name applied to the exchange of oxygen and carbon dioxide in the tissues and the blood stream, and is dependent upon the flow of blood through the capillaries. In external respiration the movement of the air is accomplished by inspiration and expiration. Meltzer and Auer maintain an artificial respiration by imitating internal respiration, and supplying a constantly flowing stream of air under moderate pressure (15 to 20 mm. mercury) in one direction, which carries the air to a certain distance, the remainder of the distance being covered by diffusion aided by the currents excited. A tube two-thirds the diameter of the trachea is passed through the mouth, larynx, and trachea, down to the bifurcation, and then withdrawn a short distance. The pressure is supplied in the original apparatus by a foot-bellows; the air is passed through an ether bottle, and the pressure measured, of course, by a manometer. Like the masks, it is at once an artificial respiration and etherizing apparatus. There is a backward flowing stream of air which keeps the larynx and pharynx free, and anæsthesia is rapid and com-

plete; and strange to relate, overdosing with ether seems impossible. The lungs are distended, breathing is deep and regular, and interruptions of the current or reductions in pressure once or twice a minute permit temporary collapse of the lung, and aid in the diffusion of the gases.

With the aid of this simple apparatus Carrel [16] [17] has done some of his most wonderful work on the lungs, the heart, and great vessels, and the œsophagus, and finds it perfectly satisfactory; while Elsberg [18] [19] has modified and refined it by substituting an electric motor, blower, warming, and filtering apparatus, etc., to meet the exigencies of operations upon man, preserving, however, its principle. Both he [19] [20] and Lilienthal [21] bear evidence to its satisfactory action in varied types of cases. It is perhaps but natural that this comparatively simple mechanism should excite the fine scorn of Meyer,[22] who, in the discussion following its presentation, contemptuously termed it the "blow-pipe method" and opposed its utility in anything but experimental work, viewing it as a backward step of fifteen years. Some of his objections seem valid, while others have been met by the modifications already mentioned, which, as Meyer prophesied, rob it of some of its simplicity. It is a true positive pressure method after all, as Janeway pointed out in discussion, due to obstruction to the backward flow of air. It is not easy to pass a rubber tube unaided into the larynx of an adult, even for one who has had considerable experience in intubation, as we can vouch, and Elsberg uses a Jackson speculum. The interference with the toilet of the mouth and with instrumentation on the œsophagus may also militate against it; as may also a deleterious action of the air and ether vapor on the bronchi, if such be proven (Janeway).

In closing the review of this part of the subject, it will be seen that, as said before, it is generally acknowledged that there is no great advantage of one form of differential pressure over the other, as far as our present knowledge goes. Expansion of the lung can be maintained, and natural or artificial respiration preserved or practised by both methods.

Mention might be made here of the practical application to many lesions of the thoracic viscera, including the œsophagus, of both forms of pressure. To which modification we will finally come, or whether one form will be found superior under certain conditions and another under other conditions, is still more or less an unsettled question; but that differential pressure has come to stay is certain. With Meyer's universal cabinet he claims that exploratory thoracotomy is as safe to-day as is exploratory laparotomy, thus gratifying Friedrich's wish, which statement, with certain limitations, now to be taken up, may be considered true.

### TECHNIC IN THORACIC SURGERY.

The importance of a most rigid technic in all operations upon the pleura, and the direct influence of infection upon the operative results are now well recognized. In both experimental and clinical work infection shares in importance with and outclasses pneumothorax as a most dangerous complication. This has been strongly brought out in an analysis of the deaths after operation in cases of wounds of the heart, 45.4 per cent. of which, according to Guibal (Matas[23]), are directly due to septic infection of the pleura or pericardium or of both; in Stuckey's [2] series of cases of lung suture, infection was the most frequent cause of death. The well-known experiments of Notzel show greater susceptibility of the pleura to infection than is the case with the peritoneum, although less than that possessed by the synovia of the joints. The pleura possesses considerably more resistance when closed than in the presence of pneumothorax. The cessation of lung activity associated with pneumothorax means disturbance of the circulation in both the blood and lymph channels, and the resistance of the pleura at once collapses.

Carrel,[17] in a recent article on the experimental surgery of the thoracic aorta and the heart, reminds us again of the fact that we are in danger of forgetting, viz., that the bulk of so-called aseptic wounds are almost always slightly infected. What would be a negligible infection elsewhere, in the pleura

becomes an important and threatening condition. Among the measures which favor such infection, Carrell includes handling with forceps and retractors, sponging, walling off with gauze, and the exposure of large surfaces to the air. Hence the innovation he practises. These are: the covering of the lung with silk compresses impregnated with vaseline, to prevent evaporation and drying of the tissues, and these covered in turn with thick flannel to prevent cooling; the exclusion of blood from the pleural cavity, and the avoidance of handling and sponging. Moreover, the operating room is kept at a high temperature, and using these precautions, he operates successfully on the œsophagus, the lungs, and the pericardium, discarding many of the suggestions, appliances, and methods of technic found necessary by other experimenters in the same field.

The relationship of pneumothorax to infection, the loss of pleural resistance associated with its presence, and the added resistance afforded by complete closure and air exclusion, will be seen to be of prime importance in considering the whole question of operations on the lung, and more acutely, the question of drainage. From our own slender experience it has always seemed that while the pleura was easily infected, and while drainage was usually followed by infection, it was rather quickly thrown off if the drainage was adequate. But such a position is no longer tenable, if taken as an excuse for the use of drainage as a routine measure or even in cases of doubt. Nearly all the statistics quoted by Matas, in his masterly article on heart wounds in Keen's "Surgery," support the view that a patient's chances are better without pleural drainage; and a study of the more or less exhaustive papers on wounds of the lung, published within the last two years, from the clinics of Körte, Trendelenburg, and Brunner, confirm this opinion. Only by the restoration of the normal physiological conditions, in whole or in part, can infection be satisfactorily controlled.

The practical applications of these considerations in regard to technic leads us to the question of wounds of the pleura

and lung, and of these the latter are by far the most important.

WOUNDS OF THE PLEURA AND LUNG.—In another part of this paper we alluded to the views which were commonly accepted and those which were new some ten or twelve years ago. The conservative treatment of such wounds is familiar to every medical student. Rest, with sealing, suture, or tamponing of the external wound, strapping of the chest, cold externally, and morphia are routine, and for the attending surgeon, easily applied and satisfactory measures. What are the untoward consequences to the patient of a too universal application of such treatment? He may continue to bleed into his pleura, and a huge hæmothorax result. If a large bronchus be wounded, with each inspiration air will be pumped into that sac, and failing means of escape externally, compress first the wounded lung, and then by pushing over the mediastinum to the opposite side, displace the heart, press upon the sound lung, and cause kinking of the great vessels and the large bronchi, and result in suffocation from "pressure pneumothorax;" or emphysema may appear, in the presence of a wound in the chest wall, or extend through the mediastinum into the root of the neck and such escape give only temporary relief from pressure. If the patient survives or escapes these immediate dangers, infection frequently develops later, introduced from without through the chest wall or from within through an open bronchus, and empyema results; or secondary hemorrhage, the result of a wound from a small calibre jacketed bullet, may finally carry him to his grave, a complication especially noted during the Boer War. Even if he escapes these accidents, experience has shown that a patient who does well in the early period may be invalided by the development of respiratory and circulatory crippling, the result of hæmothorax, as noted in the Russian-Japanese War (Küttner). Besides the conservative and expectant treatment, it behooves us to consider the other measures which have been recommended. Aspiration for the removal of blood and air from the pleura is the most frequent minor measure. The permanent insertion of a tube between the

ribs, either to favor collapse of the lung and thereby encourage hæmostasis (Le Conte), or to allow the escape of air under pressure, in the latter case providing it with some valve mechanism to prevent admission of air from without (Hopkins, Tiegel), have both been advocated. Thoracotomy, followed by evacuation of the blood from the pleura and direct control of hemorrhage, is the most recent and apparently the ideal method.

To Garré [24] of Königsberg is due much of the credit for pointing out the urgent necessity in a certain number of cases for the institution of active surgical measures for direct control of hemorrhage from a wounded lung. In this epoch-making article, read before the Thirty-fourth Congress of the Deutsches Gesellschaft für Chirurgie in 1905, he presented the results of a statistical study of 700 wounds in the lung treated conservatively, dwelt upon the high mortality under such methods of treatment, and exposed some of the fallacies which had long influenced the treatment of these lesions. He pointed out that the general mortality was over 40 per cent.; in ruptures of the lung, uncomplicated by other injury it exceeded 50 per cent.; while stab wounds and gunshot wounds in the antiseptic era exhibited a death-rate of 38 per cent. and 30 per cent. respectively. He also clearly demonstrated that antisepsis as ordinarily applied could not favorably influence the internal wound which opened the lung itself; that the small calibre jacketed bullet was as dangerous as the old-fashioned projectile; and also asserted that the often repeated view that bleeding spontaneously ceased in the collapsed lung had neither clinical nor experimental confirmation. The prime indications for operation, according to Garré, were hemorrhage, abundant, persisting, or recurring, and pressure pneumothorax not yielding to aspiration. While they were only present in 5 or 6 per cent. of cases of lung injury, they demanded prompt interference. He collected nine cases of suture of the lung, including one case of ruptured lung (his own) with six recoveries. The principles of treatment, as he laid them down, are not very different from those found useful by his followers; nor has

his technic been greatly modified, except as influenced by the facilities afforded by the development of differential pressure and a better understanding of the influences of pneumothorax and its relationship to drainage.

Since the appearance of Garré's article, a number of other important contributions have appeared, including those of Küttner, Sauerbruch, Hotz, Stuckey, V. Möller, Wolf, and Grassmann. The last three, coming from the clinics of Körte,[25] Trendelenburg,[26] and Brunner,[8] have appeared within a year or two, and set forth what may be accepted as the authoritative teaching at this time as contrasted with the extremely radical views advanced by Stuckey[2] of St. Petersburg, which have received wide publicity.

In determining the indications for operation in lung wounds, it would seem desirable to restore as completely as possible the normal physiological conditions of the pleura, to check hemorrhage, remove infection or the conditions favoring its development, and prevent absolutely all danger from those accidents which we have enumerated as possible sequels of such wounds. This would seem to be the ideal treatment, and it may be that in a short time we will resort to operation as promptly as we do in gunshot wounds of the abdomen. This is practically the ground taken by Stuckey, who reports from one hospital no less than 25 wounds of the lung subjected to operation and suture—an enormous number when contrasted with the sum total of those gathered from the literature by a number of investigators. Stuckey advises thoracotomy and suture in every stab wound of the chest seen within twelve hours of the time of its infliction. His cases showed a mortality of 36 per cent., and combining his cases with 7 cases of suture for stab wound from the literature, the series shows a mortality of 31.27 per cent., which he contrasts with the mortality of 38 per cent. in conservatively treated cases cited by Garré.

This paper led Körte to suggest a study of the cases in his clinic from 1891 to 1909, and V. Möller[25] reports them *in extenso*. This paper represents the more conservative attitude which would restrict operation to cases exhibiting

certain well-defined symptoms. In 48 gunshot wounds there was a mortality of only 14.6 per cent., while of 19 stab wounds the mortality was nil. Of 23 cases of subcutaneous rupture of the lung, 9 died, a mortality of 39 per cent. The operations included aspiration, the most frequent operative procedure; thoracotomy only twice; one suture of the lung; one tamponing of the pleura; and one or two laparotomies. V. Möller argues that in only two of the fatal cases of penetrating wounds could death have been prevented by prompt operative treatment, using our modern technic; nor was empyema more frequent than in Stuckey's series; and the lack of mortality and the much shorter period of healing in his stab wounds, is in striking contrast to Stuckey's results.

Grassmann [26] takes a view very similar to that of V. Möller, in restricting thoracotomy to certain rather sharply defined conditions.

The favorable outcome of some of the most desperate cases, without operation, is the stumbling block in determining when to interfere. Wolf [8] reports four cases recovering after suture of the lung—one of rupture, a very rare case, two cases of gunshot wounds, and one of stab wound, operated by Trendelenburg himself. Positive pressure was used in the first case throughout the operation, and in the last case to remove the air from the pleura and to distend the lung before closure of the chest wall. Drainage was dispensed with in all.

The binding indications for operation in penetrating wounds of the chest would seem to be as follows:

1. A wound which from its situation and direction would render likely a penetration of the heart, pericardium, or diaphragm.

2. Severe primary or recurring hemorrhage, as shown by the physical signs of hæmothorax or external bleeding, or by severe hæmoptysis with threatened aspiration of blood into the other lung.

3. Secondary hemorrhage, especially to be looked for in gunshot wounds.

4. Severe pneumothorax, especially when accompanied by symptoms of mediastinal and cardiac displacement, dyspnœa, cyanosis, and threatened suffocation, and which is not relieved by aspiration; also when extensive and increasing external emphysema is present.

5. Secondary pneumothorax, which is always due, according to V. Möller, to suppuration or sloughing of lung tissue.

6. Empyema.

It seems certain that with the improvements in our technic, which include greater familiarity with methods of differential pressure, that these indications will increase in number rather than diminish, and that the ideal treatment, already mentioned, will in time become the accepted one; but a checking up of the results from time to time by our mortality and morbidity statistics should accompany the gradual adoption of more sweeping indications.

In a very limited series of chest wounds under our own observation, the following cases were operated:

1. A stab wound of the chest in the fifth interspace, anterior axillary line, left side, with free external and internal hemorrhage. Treated by prompt rib resection, suture of the wound in the lung, drainage of the thoracotomy wound, and posterior drainage, according to the method of Delageniere. Recovery.

2. A stab wound of the chest in the eighth interspace, anterior axillary line, left side, with moderate external bleeding and traumatopnœa. Treated within a few hours by enlargement of the wound, exploration of the pleura, lung, and diaphragm, cleansing of the pleura, and closure of the wound, with superficial drainage only. Recovery.

3. A stab wound of the chest in the second right interspace, two and a half inches from the sternum, which entered obliquely and divided the internal mammary artery. Operated for recurrent hemorrhage the same day. Ligation of the artery. Partial closure, with drainage. Death from hemorrhage.

4. A case of stab wound in the second interspace, left side. Admitted during Dr. Wharton's service, and treated at first by conservative measures, and later by aspiration on two occasions. Empyema developed, and we resected a rib five weeks after his admission. Recovery.

5. A stab wound of the chest penetrating the pleura between the scapula and the spinal column, and associated with multiple non-penetrating wounds of the back. Operated within a few hours for persisting hemorrhage and hæmothorax. Owing to the position of the wound exploration was unsatisfactory, and tamponing was resorted to. Infection of the pleura followed, and rib resection and drainage were finally necessary. Recovery.

6. A gunshot wound of the chest, self-inflicted, in the third interspace, left side, one and a quarter inches from the sternum. Operated the same day for suspected wound of the heart. Thoracotomy and formation of a quadrilateral chondroplastic flap. Pericardium uninjured. Temporary control of hemorrhage by insertion of large gauze laparotomy pads. Spontaneous cessation of hemorrhage, and closure of the wound with superficial drainage only. Death in four days from delirium tremens.

7. A gunshot wound of the chest below the precordial region on the left side, with penetration of the diaphragm, gastrohepatic omentum, and kidney. Laparotomy performed the same day, stomach and intestines examined and found uninjured. Temporary improvement, interrupted by streptococcic throat infection, otitis media, and symptoms of lung infection on the right side, with sudden unexpected death several days later. No autopsy.

8. We have also operated upon one case of rupture of the lung, in which the most alarming thoracic shock was present for 36 hours, and which developed empyema later, for which rib resection was done. This patient recovered.

It seems to us that this list, small as it is, emphasizes some of the accidents, immediate and remote, which are frequently met with in chest wounds and injuries. It includes only one case of wound of the diaphragm, treatment of which by the transthoracic route has certain advantages which are now recognized. Nor does it include any well-defined case of "tension" or "pressure" pneumothorax so called (Spannungspneumothorax), which is one of the most urgent indications for operation, or any wounds of the pericardium or heart. But our experience has been sufficient to convince us that the too optimistic views often voiced in regard to chest wounds, and an over-conservative attitude in their treatment, will sooner or

later lead us all into trouble, and that the attitude which we are now forced to assume is one which is based not alone on physiological and experimental but on truly clinical grounds.

*Operative Technic.*—Where differential pressure is available, it will usually be employed; or if not used throughout the entire operation, it is useful at its termination before closure of the opening in the thorax, to distend the lung and abolish pneumothorax. It has been used in a number of cases of wound of the lung with the greatest satisfaction, five cases being collected by V. Möller.

Elsberg [27, 28] emphasizes the fact that both in experimental and clinical work the patient breathes better if lying in the prone position when the chest is opened, and he has recommended this position in operations on the lungs and pleura. The weak anterior mediastinum receives more support in this position, and coughing and respiratory disturbances were absent in empyema cases so operated, while the exposure was excellent. We have tried it in several cases with good results.

The remarks on the aseptic technic, already quoted, are to be borne steadfastly in mind. They need no repetition.

In the presence of a wound, the opening in the chest wall should usually be planned to include it, unless in operating late for infection alone, when the site for drainage is chosen according to the indications common to empyema cases of other origin. Resection of one or more ribs or the formation of an osteoplastic flap is advisable. Intercostal incision, with the use of a powerful rib spreader, is feasible. The lung is at once seized and pulled outward into the wound, using the hand and holding the lung with moist compresses, as Rehn recommends, or adopting the suggestion of covering the rubber glove with a cotton glove to obtain a firmer grasp. Instruments are prone to lacerate the lung tissue. Traction on the lung, drawing it into the wound, as recommended by Rehn, is especially useful when differential pressure is not used, as entrance of air into the pleura is in a measure prevented, while the traction on the mediastinum steadies it and helps to overcome the respiratory and circulatory dis-

turbances incident to pneumothorax. An examination of the surface is then made for wounds and lacerations. Wounds are sutured whether bleeding is present or if it has ceased, unless situated at the hilus and not accessible for suture, when tamponing may be necessary. In such cases Bramann recommends suturing the wound in the parietes around a large tube provided with a rubber tissue valve. In gunshot wounds the wound of exit from the lung must not be forgotten; failure to suture it may result fatally, as recorded in one case (Delbet).

Lacerated and badly soiled areas may call for excision, preferably wedge-shaped, while clots and foreign bodies are to be removed. The sutures, either of silk (as Talke prefers) or catgut, passed with a round pointed needle, are inserted near the edge of the wound, and penetrate the entire depth, being tied firmly enough to secure hæmostasis and occlusion, but not so tightly or so closely as to cause atelectasis. The visceral pleura may then be sutured over the wound to secure early occlusion. The lung tissue itself heals readily when the wound edges are neatly approximated. Broad lacerated surfaces may be sutured into the wound, shutting off the general pleural cavity (Jonnesku); especially if suturing fails to control hemorrhage (Brunswig). The pleura is cleansed of blood and clots, and preparations made for closure of the wound. Where differential pressure is not used to secure expansion of the lung, it is recommended by Bayer to suture it to the wound in the parietes before closure, as this favors expansion; otherwise it is released and the wound closed by layer suture with superficial drainage. Drainage of the pleura in primary cases is usually contraindicated for the reasons already given. Wolf's report of four successful cases, including one stab wound, two gunshot wounds, and one of rupture of the lung, all treated without drainage, is very convincing.

When packing is necessary in an inaccessible wound, or when gross infection is present, as shown by pleural exudate, and exceptionally under other circumstances, as when a large bronchus is wounded and cannot be sutured, drainage will be

necessary, and under such circumstances drainage posteriorly is preferable (Delagenieres' method).

Of 26 cases of gunshot wound collected by V. Möller, operated according to the usual indications of hemorrhage, pneumothorax, emphysema, or suspicion of heart injury, 11 died (42 per cent.); 20 were sutured with 7 deaths; 2 were sutured to the opening in the pleura, with 1 death; 2 in which the lung was resected died; and 1 in which the pleura was packed, recovered.

Of stab wounds he collected 10; 7 were sutured, with 1 death; and 3 were treated by tamponing the pleura, with no deaths. There were also 19 unclassified injuries to the lung, of which 18 were sutured, with 7 deaths; and 1 case treated by tampon, which recovered.

Stuckey's cases, operated without regard to the usual indications, are not included in these statistics, which are the most elaborate and most recent, although not complete as regards the American literature.

In *rupture* of the lung the question of operation is also to be carefully considered before interference is practised or discarded. The mortality is higher than in the case of penetrating wounds, being 50 per cent. after deducting all deaths due to accompanying injury to other organs (Richter-Wolf). If operation is to be of value, it must usually be practised early, as the lacerated lung, lying in a pleura filled with blood, soon becomes infiltrated and hepatized, as shown by Garré. The pneumothorax which is due to a limited laceration of the parenchyma, like that associated with small penetrating wounds, may be of trifling significance; but if a large bronchus be torn, air may be pumped into the pleura with each inspiration, and its exit hindered by a valve-like closure of the bronchus. Dangerous or fatal pressure on the heart and the opposite lung quickly results under these conditions. Profound shock is a familiar picture in these cases, and after it passes away, hæmothorax, pneumothorax, and wide-spread emphysema often develop. The cases associated with fracture of the ribs give the highest mortality. Wolf says that if, after

the period of initial shock has passed the patient's facies show an increasing paleness and cyanosis, or if signs of hæmothorax, with difficult breathing, small frequent pulse, and anxious expression are present, operation is indicated. Garré operated for rupture of the lung on the fourth day after the injury, too late to save his patient, but Wolf was more fortunate in his case. He operated under positive pressure, sutured a tear in the lower lobe 5 cm. in length (the site of active hemorrhage), cleansed the pleura, elevated a depressed and fractured rib, sutured it in place, and closed the pleura without drainage. The patient recovered, a triumph of surgery.

## REFERENCES.


[1] Küttner: Deutsche Zeitschrift f. Chirurgie, 1908, xciv, 1.
[2] Stuckey, L.: Archiv. f. klin. Chirurgie, 1909, lxxxviii, 767.
[3] Hopkins, B. H.: Trans. Phila. Acad. of Surgery, April, 1900.
[4] Jopson, J. H.: Trans. Phila. Acad. of Surgery, Oct., 1905, ANNALS OF SURGERY, 1906, xliii, p. 150.
[5] Kelly, Jas. A.: Trans. Phila. Acad. of Surgery, Nov., 1909, ANNALS OF SURGERY, 1910, li, p. 275.
[6] Howell, W. H.: Text Book of Physiology, 3d Ed.
[7] Robinson and Leland: Surgery, Gynæcology and Obstetrics, 1909, viii, 255.
[8] Wolf, W.: Brun's Beiträge z. klin. Chirurgie, 1910, lxvi, 51.
[9] Robinson, S.: Surgery, Gynæcology, and Obstetrics, 1910, ix.
[10] Tiegel, M.: Brun's Beiträge z. klin. Chirurgie, 1910, lxviii, 584.
[11] Green, N. W., and Janeway, H. H.: ANNALS OF SURGERY, 1910, lii, 88.
[12] Fell, J. E.: Surgery, Gynæcology, and Obstetrics, 1910, x, 572.
[13] Meyer, W.: Jour. Amer. Med. Assoc., 1909, liii, 1978.
[14] Tiegel, M.: Brun's Beiträge z. klin. Chirurgie, 1909, lxiv, 356.
[15] Meltzer, S. J.: Med. Record, 1910, lxxvii, 477.
[16] Carrel, A.: Med. Record, 1910, lxxvii, 491.
[17] Carrel, A.: ANNALS OF SURGERY, 1910, lii, 83.
[18] Elsberg, C. A.: Med. Record, 1910, lxxvii, 493.
[19] Elsberg, C. A.: ANNALS OF SURGERY, 1911, liii, 161.
[20] Elsberg, C. A.: ANNALS OF SURGERY, 1910, lii, 23.
[21] Lilienthal, H.: ANNALS OF SURGERY, 1910, lii, 30.
[22] Meyer, W.: Medical Record, 1910, lxxvii, 483.
[23] Matas, R.: Keen and Da Costa's System of Surgery, vol. v.
[24] Garré, C.: Archiv. f. klin. Chirurgie, 1905, lxxvii, 209.
[25] V. Möller: Archiv. f. klin. Chirurgie, 1909–10, xci, 295.
[26] Grassmann, M.: Münchener med. Woch., 1909, lvi, 2089.
[27] Elsberg, C. A.: Jour. Experimental Medicine, 1909, ii, 444.
[28] Elsberg, C. A.: Med. Record, 1908, lxxiii, 846.

## INJURY AS A CAUSATIVE FACTOR IN CANCER.*

(*Continued from page 488 of last issue*)

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I have personally observed only very few cases of intra-abdominal cancer definitely associated with antecedent trauma. One of the most striking cases in which I found any connection between an injury and the subsequent development of a tumor was one in which I was called as medical expert some years ago. Inasmuch as in this case (Dr. H. B. Delatour's of Brooklyn) the relationship was much more definite than in the case cited by Segond, I feel warranted in giving a somewhat detailed history of the case here:

CASE VIII.—E. P. F., male, forty-four years of age. In December, 1898, in an accident of the Pennsylvania R. R., patient was thrown violently against a water tank, striking in the upper abdomen, causing marked ecchymosis, nausea, and pain, some vomiting of blood, which lasted for two to three weeks. He was confined to the house for about three weeks. He continued to get worse, and in February, 1901, he was seen in consultation by Dr. Delatour. No tumor could be felt at that time. In May, 1901, a mass could be made out in the right upper abdomen. An exploratory operation was performed, and a large number of tumors of the mesenteric glands were discovered. The patient died of shock following the operation. Autopsy showed the mesenteric glands in the upper abdomen markedly enlarged, some being the size of a hen's egg. The pancreas was likewise involved by similar growths. Microscopical examination showed the growths to be sarcoma. At the first trial in court, the jury disagreed and a settlement was effected before the second trial was called.

CASE IX.—*Intra-abdominal cancer following trauma. Carcinoma of the ovary.*

Mrs. W., age fifty-seven years. Family history good. In the early part of 1909 had such a severe fall upon the ice, that she felt as though her bladder had been ruptured. Three or four weeks later, noticed a lump in the lower abdomen. She was operated upon by Dr. Wynkoop, March 16, 1909; a large tumor was removed from the right ovary. Microscopical examination showed it to be malignant. July, three months later, a very extensive recurrence was found occupying the whole lower abdomen. This increased very rapidly in size. I saw patient in August, 1909, at which time the whole abdomen was filled with a large tumor apparently connected with the uterus. It had the appearance of carcinoma rather than sarcoma. Toxin treatment was tried for a number of weeks, but patient showed no improvement. Death occurred a few months later.

The medicolegal aspect of the question of the relationship of trauma to the development of cancer has been very carefully considered by Segond. He believes the following to be the most important points in this connection:

1. Age of a person injured.

2. Predisposition, both general, *e.g.*, hereditary, and acquired or local predisposition by way of previous inflammations or irritation. (Predisposition is not considered by the French or German courts.)

3. The condition of the locality prior to the injury.

As regards age, if younger than the ordinary age for the development of carcinoma, the responsibility of the accident would be augmented. This, however, is a special consideration, rarely applicable.

As to the state of the part before the accident, this is the most important of all considerations, and every effort should be made to determine this. In a medicolegal examination, the following points should be established:

1. The exact diagnosis of the tumor.

2. What changes may have occurred at the injured site between the time of the accident and the development of the tumor.

3. The exact interval that elapsed between the injury and the development of the tumor.

Segond gives five so-called guarantees that he regards necessary to establish the connection between the injury and the tumor:

1. The authenticity of the trauma.
2. Sufficient importance or severity of the trauma.
3. The integrity of the part prior to the injury.
4. Correspondence of the tumor to the exact site of the injury.
5. A date of appearance of the tumor, not too remote from the time of the accident to be reasonably associated with it.

The interval elapsing between the injury and the development of the tumor, Segond regards as an exceedingly delicate question. Certain authors have put into exact figures the time during which the tumor should develop to be reasonably associated with the injury. René Sand states that in sarcoma the interval should be between 3 weeks and a year; in carcinoma, from 6 weeks to a year; in glyoma, 1 month to 6 years; other tumors, 3 weeks to 2 years.

Machol states that a sarcoma of traumatic origin should develop 3 weeks or more after the accident; a carcinoma up to 2–3 years or even later. Heckinger estimates 2 years as the extreme limit within which a trauma can be reasonably regarded as playing a causative rôle.

Segond regards any absolutely definite time limit, as attempted by the preceding writers, to be of no value. According to same, he says, one might have to rule out a sarcoma which developed immediately after a traumatism. To the question, "Should one rule it out?" he replies: "by no means, nor inversely, can we rule out injury as a causative factor in epithelioma which resulted more than 3 years after the accident."

A sixth guarantee regarded of considerable importance by some writers is the continuous presence of pathological manifestations, such as pain, swelling, hæmatoma, etc., at the site of the injury up to the time of the appearance of the tumor.

Segond would add a seventh guarantee, namely, a histological verification of the cancer. This, would, of course, mean its removal by operation.

In conclusion he states that when these seven conditions just described have been fulfilled, one is able to accept the responsibility of the accident; and even when the guarantees are reduced to the first five, the same conclusion would hold before the law, and we have the right to award an indemnity, although we may still entertain scientific doubts.

My own experience with the medicolegal side of this question is confined to three cases:

CASE X.—*Sarcoma of forearm—spindle-celled.*

Mrs. B., aged thirty-eight years, had always been in perfect health; no family history of cancer. During an ocean voyage was struck over the middle of the upper part of the forearm by a falling wash-bowl in the cabin, causing a slight bruise. This disappeared. Two to three weeks later, at the exact site of the injury, there developed a small, hard tumor which rapidly increased in size and was removed when it had reached the size of an olive. Microscopical examination proved it to be spindle-celled sarcoma. It recurred locally several times, and in spite of toxin treatment and amputation at the shoulder-joint, proved fatal within two years.

Suit was brought against the S. S. Co. Two trials resulted in a disagreement of the jury; at the third trial the jury gave a verdict of a large sum in favor of the plaintiff.

CASE XI.—*Sarcoma of the retroperitoneal glands involving the pancreas* (already cited in another connection as Case VIII).

E. P. F., male, age forty-four years. December, 1898, in a railroad accident was thrown violently against a projecting water tank, striking upper abdomen. Some vomiting of blood, pain, and nausea, lasting from two to three weeks. Patient was confined to his house for three weeks. Next two years was disturbed by epigastric pain and vomiting, sometimes blood. Careful examination by Dr. Delatour, February, 1901, showed no tumor. Two months later, tumor could be felt in right upper portion of abdomen. Exploratory operation showed a large number of tumors in mesenteric glands. Patient died of shock following operation. Autopsy showed glands in upper abdomen greatly enlarged. Microscopical examination of tumors showed them all to be sarcoma.

Case tried against the Pa. R. R. resulted in a disagreement of the jury. It was finally settled out of court.

CASE XII.—*Carcinoma of the liver, primary, following severe injury.*

J. T., male, aged thirty-five years; always enjoyed good health until December, 1909, when he was injured in a train collision in which the car was nearly telescoped. His injuries consisted in severe and very extensive general contusions, principally of the head, spine, and sacrolumbar region. He was unable to walk after the accident, and remained in bed for 4½ weeks. It was at first believed that he suffered from a fracture of the spine. He gradually became stronger, so that he was able to walk moderate distances, and on March 24, 1910, when I first examined him he could walk about a mile. He then had lost 24 pounds in weight and suffered constant pain in the back. Physical examination at this time, three months after the accident, showed the following: weight had fallen to 111 pounds (normal weight 175 pounds), the skin was soft and flabby, showing evidence of rapid loss of weight. Temperature, 99.5°; pulse, 88; knee-jerks exaggerated; sensation normal. Examination of the abdomen showed nothing abnormal, except very marked rigidity in the muscles of the upper abdomen, particularly in the recti muscles. There was marked tenderness in the dorsolumbar region and spine. The X-ray showed an abnormality in this region of the spine, but no evidence of a fracture.

I made a second examination of the man on June 28, 1910, three months later, and found him to have gradually failed since the first examination; his weight had fallen to 106 pounds. He was markedly emaciated, somewhat cachectic in appearance; he could still walk, but was rather feeble. Patellar reflexes were still much exaggerated and sensation considerably diminished in thighs and legs. Examination of the upper abdomen showed, in addition to marked rigidity of the recti muscles, a hard swelling in the epigastric region, a little to the left of the median line, apparently intra-abdominal. My notes of the case state: "The tumor is apparently located in the stomach or the omentum overlying the stomach, and is in all probability of malignant nature." In my diagnosis, I stated: "I believe that the claimant is suffering at present chiefly from a tumor of the stomach and omentum, probably malignant in nature. He will probably not live more than six months." The patient died on Sept. 24, 1910, and autopsy showed an extensive carcinoma, involving nearly all the abdominal organs, but apparently primary in the liver.

The pathologist was unable to determine whether the tumor was carcinoma or sarcoma, but that it was a malignant tumor there was no doubt.

While it is impossible to say that the injury in this case was the cause of the development of the tumor, the probabilities in favor of a causal relationship are much stronger than in many cases in which such relationship has been accepted abroad. Here we have a man in perfect physical condition prior to the accident, direct evidence that he suffered from extensive contusions, rapid and continuous failure of health immediately after the accident, marked rigidity of the epigastric region three months after the accident, with the development of a large sized malignant tumor found six months later, in the same region.

NOTE.—This case never came to trial, for the reason that the person resided in a State in which there existed the peculiar law that, "if the next of kin be an alien or non-resident," no suit for recovery of damages is permitted

During the discussion at the French Congress of Surgeons in 1907, Professor Thiem, of Cottbus, stated that Virchow thought that irritative causes must be of very great importance in the origin of abnormal tissues, especially in the cause of cancer. Among these irritative causes are chronic inflammation, cicatrices, bacterial irritation, and, more rarely, a single trauma. Thiem admits that the cause of carcinoma is still plunged in darkness. We cannot, for this reason, fail to recognize from clinical observation that, in rare cases, cancerous tumors may develop at the site of an injury, not only after prolonged and repeated injury, but also after a single trauma. Just how they do originate, we do not know. He believes that it is impossible that a trauma determines the site of a metastatic growth, that is to say, that a bruised or contused point may furnish favorable ground for the development of a cancerous embolism. The transported cell of the carcinoma is in need of living tissues for continuing its development.

My own case (Case II) proves the direct opposite of this contention, at least for sarcoma.

In connection with the medicolegal aspect of the question of the influence of trauma upon tumor development, Thiem (Second International Conference for the Study of Cancer, Paris, Oct. 1–5, 1910) states that inasmuch as the true cause of cancer is as yet shrouded in darkness, it is all the more important to investigate the contributive causes, such as trauma (acute, repeated, or continued), heredity, contagiousness, etc. Among the various contributive causes he considers as deserving of special attention the determination of the influence of a single blunt or acute trauma upon the development of a cancer. He holds that *every wound,* whether it heal by primary union or not, or whether it result in abscess or fistula formation, may contribute to the development of a cancer by virtue of the inflammatory irritation and cicatrization, and he also believes that the same conditions obtain in cases of blunt injury in which the *skin or mucous membrane remains intact.* Here, too, he states, we have to deal with processes of inflammation or restitution which are capable, just as in an open wound, of acting as an irritant upon the tissues. However, there is a difference. The comparatively favorable course of subcutaneous injuries implies a more rapid healing process. It is not to be assumed that in such cases as healing without leaving any anatomical changes, a condition of irritation sufficient to appreciably contribute to the development of a cancer should persist. He, therefore, believes that a causative relationship between such blunt trauma and the development of a cancer at the site of the injury may be ruled out after two years from the time of the injury, provided, of course, that a true history, a *restitutio ad integrum,* has been obtained. With this statement I cannot concur.

Thiem places emphasis upon the point that the irritation caused by a trauma is but one of the auxiliary causes, though perhaps the most important, in the development of cancer. That the main cause, the as yet " unknown quantity," must be added is shown by the following case of Beigel's: In a man, seventy-four years of age, both of whose feet had been operated upon at Lisfranc's joint during childhood, a cancer devel-

oped in the cicatrix of the right side, and on the left, a cornu cutanea.

Röpke (*Habilitationsschrift,* 1905) tries to throw some light upon the question of the significance of trauma for the development of carcinoma and sarcoma. He bases his observations on a study of the material at the Surgical Clinic at Jena. His statistics show that in a series of 800 cases of carcinoma plus a larger number of cases in which the carcinoma developed as a result of chronic irritation, only 19 were caused by one single trauma. In a series of 189 cases of sarcoma, chronic irritation was the cause of the disease in 28 instances, a single trauma in 19 cases, showing trauma to be an important factor in the development of these tumors, and showing, furthermore, that in the case of sarcoma the single trauma plays a more important rôle, while in carcinoma chronic irritation seems to more often be the cause of the disease. These facts, he believes, speak strongly in favor of Virchow's irritation theory, which, contrary to Bilroth's, does not assume a predisposition or specific diathesis for the tumor formation, but rather favors the idea of a local disposition which may be either hereditary or acquired.

Röpke holds, however, that in addition, a disposition of the entire organism as well as a family disposition has to be considered, just as in the case of infectious disease.

At the close of his article, Röpke reports two cases in which the influence of a trauma in the localization of a metastatic sarcoma could be clearly proved. In both cases a tumor developed at the exact site of contusion within one week from the receipt of the injury. The originally small metastatic tumor gradually increased until it far exceeded the primary growth in size. He calls attention to the great similarity existing between these cases and the development subsequent to a trauma osteomyelitis and tuberculosis, in which so frequently most insignificant injuries furnish the exciting cause for the localization of the infection.

Ziegler (*Münchener med. Wochenschr.*, 1895, p. 621) gives an analysis of 170 cases of carcinoma, of which 37 cases, or 22 per cent., gave a history of a single antecedent trauma. He

also quotes Estlander, who reported 59 cases with 15 single antecedent traumas, or 25.4 per cent.; Snow, with 32 single traumas in 143 cases, or 22 per cent.; Henry, 196 cases with 33 single traumas, or 16.8 per cent.

Ziegler has collected 171 cases of sarcoma, *i.e.*, 81 males and 90 females, with a history of a single antecedent trauma in 35 cases, and of chronic irritation (including warts) in 32 cases.

The highest percentage of cases of antecedent trauma in sarcoma, especially of the long bones, is that brought out by Samuel Gross in his classical paper on sarcoma of the long bones. In 165 cases there was a history of previous injury in nearly 50 per cent.

The most exhaustive paper, dealing with the subject of traumatic tumor formation, is the one by Carl Löwenthal (*Arch. f. klin. Chir.*, Bd. xlix, 1894–5). The paper occupies 200 pages of text and contains a very complete bibliography comprising 360 references prior to 1895.

He states that on the basis of his material, viz., 750 collected cases plus 50 observed at the Pathological Institute of Munich, the conclusion would seem justified, that external injury may undoubtedly give rise to the development of a tumor, therewith admitting the direct etiological relationship between trauma and tumor formation.

Three hundred and fifty-eight, or 44.7 per cent., of the cases were carcinoma; 316, or 39.5 per cent., sarcoma.

As regards the ages of the sarcoma cases, Löwenthal's statistics show the greatest number to have occurred between the twenty-first and thirtieth years, namely 65 per cent. of 297 cases in which the age was stated. The youngest patient was 5 months, the oldest 78 years at the time of observation by the physician.

The time intervening between trauma and tumor formation is stated in 190 of the cases, and ranges from almost immediate appearance of the sarcoma to an interval of 49 years, *i.e.*, in 135 cases it was 1 month or less; in 33 cases it was 1 month to 1 year; in 22 cases it was more than a year.

In Liebe's table, the proportion of tumors immediately

or soon following a trauma is somewhat smaller. Of 107 cases of sarcoma mentioned in his statistics, definite data regarding the time intervening between trauma and tumor were given in 75, and in these the sarcoma was noticed within one month in 34 cases; within 1 month to 1 year in 27 cases; more than a year after the trauma in 14 instances.

Löwenthal points out as of special interest one case observed at the Pathological Institute of München, in which a sarcoma of the femur developed in the callus of a shot-wound fracture with imperfect union, that had occurred 18 years before. He states he could find but two analogous cases recorded in the literature.

Of the 316 sarcoma cases, 216, or 68.4 per cent., were men; 97, or 30.7 per cent., women; 3 sex not known.

As to the kind of trauma, it is seen that in the majority of cases the sarcoma developed from a single blunt injury; 79 times it was a fall; 56 times a kick; 43 times a blow.

As regards the frequency of tumors resulting from a trauma, statistics vary greatly. Liebe, for example, found from the records of the Strassburg Surgical Clinic, May, 1872, to May, 1881, in a series of 343 cases, 37, or 10.8 per cent., that were attributed to trauma. Of these 221 were carcinoma, with 22, or 10 per cent., of traumatic origin; 42 sarcoma, with 3, or 7.1 per cent., due to a trauma.

Wolf, in reviewing the records of the Berlin Surgical University Clinic, reported 82 cases of traumatic origin in a total of 574 cases, or 14.3 per cent., of trauma; 344 of these cases were carcinoma, with 42, or 12.2 per cent., due to a trauma; 100 sarcoma with 20, or 20 per cent., ascribable to an injury.

Löwenthal states that all the larger statistics show sarcoma to be the type of tumor which most frequently develops as a result of an injury. He refers to Gross's paper on sarcoma of the long bones, with a history of trauma in nearly one-half of the cases.

G. Wild, who collected 423 cases of sarcoma, found 15 in which an acute or single trauma was given as the cause.

Kirchner, in his statistical remarks on 76 cases of sarcoma of the long bones, found a trauma to have been the cause of the disease in ten.

Löwenstein (*Beitr. z. klin. Chir.*, Bd. iii, 1906, p. 780) of Czerny's Clinic, after reviewing the divergent opinions expressed by the various writers upon the subject of trauma as an etiological factor in tumor formation, concludes that there can be no doubt that trauma plays a rôle in the development of sarcoma or other tumors. The exact nature of the part trauma plays in this connection has not yet been determined, nor have the conditions upon which a tumor should be attributed to an antecedent injury as yet been theoretically defined.

As regards the legal importance of such connection between trauma and tumor formation, Löwenstein states that no general rules can be laid down, but that each case should be separately considered and carefully judged according to the origin of the tumor, its development, and course.

In answering the question as to why so few of the many thousands of traumas that occur daily result in a sarcoma or other malignant tumor, Löwenstein offers the following hypothesis: That there must be an individual predisposition to cancer at the time of a trauma that results in a malignant tumor, and this temporary predisposition he believes due to physiological endogenous or abnormal exogenous conditions in the general health of the individual, or, lastly, to abnormal local conditions confined to one organ. This is equivalent to saying we cannot answer this question.

CASE XIII.—*Extraspinal sarcoma of the back.*

D. S., male, age five years (Feb., 1911). Always perfectly well until June, 1910, when playing with some other boys he was knocked down and run over by an express wagon, the latter passing over his body. No bones were broken, and he was apparently not seriously hurt. Nothing unusual was noted until three months later, when he began to have pain in the left lumbar region. This continued, and gradually increased in severity. January 12, 1911, he was brought to the Hospital for Ruptured and Crippled. While nothing definite could be made out by a physical examination, in view of the location of the pain

he was admitted on the diagnosis: possible perinephritic abscess.

Early in February he developed gradually increasing difficulty in walking, not so largely due to loss of power in the legs as to the severe pain caused by walking. The patellar reflex on the left side began to diminish and was almost lost February 15.

Physical examination at this time showed no changes in sensation; slight loss of power in the adductor muscles; on the left side of the spine a very slight fulness could be seen and also felt on palpation. This fulness was apparently due to some swelling beneath the muscles, probably originating in the periosteum of the spinous processes. The clinical diagnosis of extraspinal tumor, probably sarcoma, was made.

The patient was examined shortly afterward by Dr. Pearce Bailey, who confirmed the diagnosis and could find no evidence of interspinal trouble. The X-rays showed no abnormalities in the vertebræ. February 17, under ether anæsthesia, I made an incision over the middle of the swelling; cutting through and separating the muscles I found an infiltrating growth apparently starting from the spinous processes or laminæ of the lower dorsal and upper lumbar vertebræ, to the left of the median line. A portion of the tumor was removed for microscopical examination. Clinically it had the appearance of sarcoma.[1]

This case is a good illustration of what I believe to be true, namely, that the number of cases of known antecedent trauma is really considerably smaller than the number of cases in which such trauma was actually present. The hospital history of this case made no mention of trauma. It was only the day before the operation, on my insisting that a more careful history be obtained from the parents, that the fact was brought out that the child had been run over by an express wagon in June, and yet no mention of it was made in the hospital records.

The following cases, the more interesting of the series, are given in more detail than in Tables I, II, and III.

CASE XIV.—*Sarcoma of the clavicle.* I. M. V., male, sixteen years of age. In October, 1909, slipped in going down-stairs

[1] The microscopical report showed only fibroma, but I believe too little of the actual tumor was removed for a diagnosis.

and, in trying to recover himself, caught hold of the banister, causing severe strain of the shoulder. Four weeks later he began to have pain and soreness in the same shoulder, which continued to increase. One week later, examination by a physician revealed a well-marked fusiform swelling in about the middle of the clavicle. X-ray examination, together with the clinical history and physical signs, made the diagnosis of sarcoma clear, and I immediately removed the entire clavicle. The growth proved to be a spindle-celled sarcoma.

CASE XV.—*Sarcoma of scapula.* J. N., male, age two months (June 20, 1910). Mother had difficult labor; shoulder strained at child-birth. A week afterward a tumor was noticed in the midscapular region on the right side; this grew rapidly, and two months later was three inches in diameter.

CASE XVI.—*Sarcoma of the lower jaw (delayed).* N. M., female, thirty-seven years of age; family history negative. Ran against wall in the dark, striking right side of lower jaw a severe blow, causing a black and blue area over the whole face. One year later, received another blow in the same locality. Two to three months later, noticed a bony tumor over the ascending ramus of the jaw at the site of the injuries. Operation proved it to be an osteosarcoma.

CASE XVII.—*Sarcoma of the scalp.* M. C., female, thirty-six years of age (April, 1898). Three and a half years ago, while leaning out of the window, the latter fell a distance of two feet, striking the top of her head, causing no external wounds but merely a bruise. Six months later, a tumor the size of a marble was noticed at the exact site of the injury. This continued to grow, and when it was 3 in. in diameter was removed by operation. Microscopical examination proved it to be a round-celled sarcoma. Several operations, each followed by rapid recurrence; death from general metastases three years later.

CASE XVIII.—*Sarcoma of supraclavicular region.* Mrs. J. B., aged fifty-six years; family history good. While drawing water, the windlass fell back and struck her a severe blow over the right shoulder. A few months later there developed a swelling just above the clavicle, which increased rapidly in size until it involved the entire supraclavicular, pectoral, and deltoid regions, associated with great œdema of the arm; very rapid progress of disease; death within a little over a year.

CASE XIX.—*Sarcoma of the thigh—round-celled (acute).* G. M., male, thirty-eight years of age; family history good. While getting out of a milk-wagon, struck right thigh against door of same, causing marked ecchymosis. Three to four weeks later noticed a small lump in the muscles of the thigh at the exact site of the injury. The tumor at first was very movable; grew with great rapidity, so much so, that it was regarded as an abscess; it bled so profusely on incision, that the femoral artery had to be tied later. Rapid recurrence followed several removals; death within a year from the time of injury.

CASE XX.—*Spindle-celled sarcoma of thigh.* H. M., female, thirty-nine years old; family history good. Ran against a lounge, bruising right thigh, in December, 1898. Noticed a swelling at the exact site of the injury two weeks later; this gradually increased in size; removed one year later, when it had reached the size of a fist. Rapid recurrence followed operation.

CASE XXI.—*Spindle-celled sarcoma of buttock.* Mrs. J. P., fifty-two years old; family history good. In September, 1907, fell through broken floor of veranda, receiving a severe contusion of right buttock. A swelling appeared shortly afterward, which was supposed to be a hæmatoma; this increased in size, and on removal proved to be a spindle-celled sarcoma; rapid recurrence; death within less than a year.

CASE XXII.—*Round-celled sarcoma of the supraclavicular region (acute).* Miss A. W., forty-six years of age. In February, 1909, a heavy window fell and struck her at about the junction of the middle and inner third of clavicle, causing severe bruises. One week later she noticed a swelling at the exact site of the injury; this slowly increased in size until it infiltrated most of the supraclavicular glands. Microscopical examination showed it to be round-celled sarcoma.

CASE XXIII.—*Carcinoma of breast (delayed).* Miss C., aged forty-eight years. Family history negative. In 1895 fell from bicycle and received a severe blow from the handle-bar upon the left breast. Four years later, noticed a small, hard lump the size of a walnut at the exact site of the old injury; operation two years later; removal of breast and axillary glands.

CASE XXIV.—*Multiple sarcoma—acute traumatic malignancy.* (Case of Dr. Teter's, of Newark.) H., male, sixteen years old; perfectly well until October, 1909, when he was kicked in the back while playing football. A few days later a small

swelling appeared between rectum and coccyx; this grew rapidly; was supposed to be an abscess; operation and subsequent microscopical examination proved it to be round-celled sarcoma. Recurred almost immediately and within two months thousands of small subcutaneous tumors, varying in size from a shot to a pea, appeared in all parts of the body, together with internal metastases.

CASE XXV.—*Sarcoma of scapula* (*delayed*). B. A., female, twenty-four years of age; family history negative. Seven years before the development of the tumor, while lying in a hammock, the latter broke down, causing her to fall; she struck with her shoulder-blade upon the bare floor; the injury was sufficient to cause her to faint, but she entirely recovered from it and there was no evidence of any tumor until six years later, when a hard swelling developed at the exact spot of the injury. This continued to grow rather rapidly and, on removal, proved to be angiosarcoma of periosteal origin.

CASE XXVI.—*Sarcoma of arm* (*immediately*). Mrs. J. G., aged forty-three years; family history negative. At the age of seven, in an altercation with another girl, was struck upon the left arm. A tumor developed almost immediately. Operation; rapid recurrence, and eleven operations were successively performed within the next four years, the last one being an amputation at the shoulder-joint. I saw the patient in March, 1906, at which time she had been in perfect health for 32 years. A letter from Dr. Stephen Smith, who remembered the case distinctly, states that the disease was pronounced sarcoma.

CASE XXVII.—*Sarcoma of the right femur* (*acute*). A. G., male, age fourteen years (May, 1908). Fell and injured right femur just above knee, January, 1908. Noticed bony swelling two or three weeks later. Grew with great rapidity. Three months later circumference of femur, site of tumor, measured 20 inches. Giant-celled tumor. Grew rapidly worse, causing death within six months.

CASE XXVIII.—*Periosteal round-celled sarcoma of the femur; acute traumatic malignancy.* M. M., age fifteen years (May 26, 1904); family history good. January 20, 1904, slipped and fell, striking on his left knee. No swelling noticed until three days later, when there appeared a hard swelling over the interior portion of the lower end of the femur, just above the joint. This slowly increased in size. For nine weeks he was treated

with bandages and splints. Rapid increase in size of tumor. Four months later the left femur showed a fusiform enlargement, beginning at the lower end and gradually shading off about seven inches above. Death within a year.

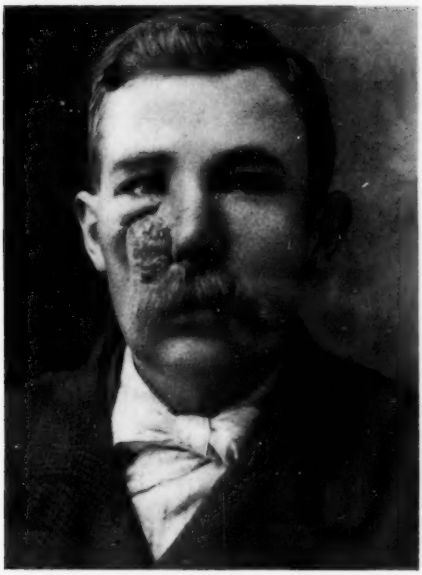
CASE XXIX.—*Periosteal sarcoma of the clavicle; acute traumatic malignancy.* J. L., age eight years (March, 1906); family history good. Had a bad fall from stone fence in October, 1905, injuring shoulder. A small lump appeared in the right clavicle a few days later. Grew with great rapidity. Tumor noticed in the right clavicle three to four weeks after injury. Operation, partial removal of tumor. Generalization. Death within five months.

CASE XXX.—*Sarcoma of the axilla and pectoral region (acute).* W. W., male, age fifty-eight years (August, 1909); family history, sister died of cancer of the womb. Fell through a barrel, striking the pectoral region against the sharp edge of the barrel, October, 1908. Had severe pain that night but no swelling or nodule. A day or two later noticed a small swelling which immediately began to increase in size. The following February, four months from time of injury, it became quite large and was removed by Dr. Matas, of New Orleans. Recurrence followed, and a second operation was performed May, 1909. Second recurrence promptly followed. Patient soon became inoperable.

CASE XXXI.—*Sarcoma of the testis; acute traumatic malignancy.* F. H., male, age twenty-seven years (July, 1898); farmer; family history good. Was perfectly well until two years ago was kicked in the testicle by a horse. Small lump appeared very soon after the injury and never disappeared. Did not increase in size until four months ago, when again injured by falling through a hay-rack, injuring the same testicle. Immediately after the old swelling of the testicle began to increase and continued very rapidly. Examination showed right testicle the size of a cocoanut. Testicle was removed. Proved to be round-celled sarcoma. Died one year later.

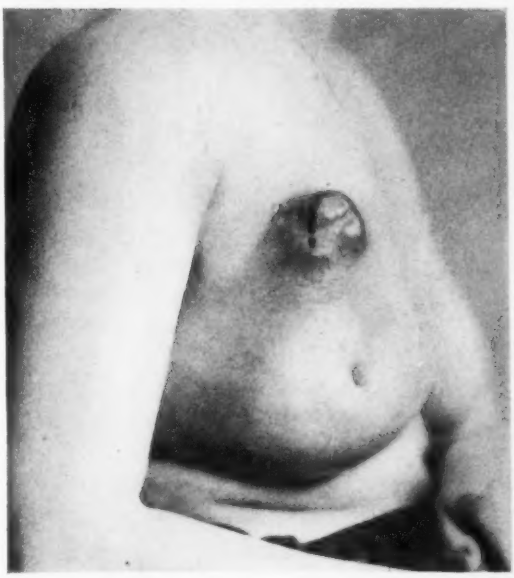
CASE XXXII.—*Acute traumatic sarcoma of the antrum.* A. Y., male, forty-one years old (February, 1902); family history good. February, 1901, was struck by the horn of a steer, causing a distinct bruise. The evidences of the bruise disappeared, but at the end of three weeks he began to have pain in superior maxilla, and a week later noticed a bony tissue on same side

FIG. 10.



Round- and spindle-celled sarcoma of superior maxilla. (Case XXXII.)

FIG. 11.



Round-celled sarcoma of breast. Acute traumatic malignancy. (Case XLI.)

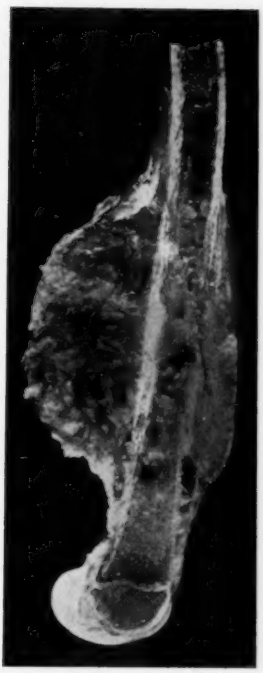
FIG. 12.

Traumatic sarcoma of femur following recent fracture of femur; direct blow from kick of horse. (Case XLIV.)

FIG. 13.

Acute traumatic malignancy three weeks after a kick. (Case LV.)

FIG. 14.



Sarcoma of femur developing three weeks after kick. Amputation, five weeks from date of injury. (Case LV.)

FIG. 15.

Shows condition 2½ months after removal of double carcinoma of breast, with very extensive axillary involvement. Patient gained 10 pounds. No swelling of arms. (Case LIX.)

FIG. 16.

Acute traumatic malignant carcinoma developing one month after having been struck on breast by a batted base ball. (Case LXII.)

which proved to be round- and spindle-celled sarcoma. Superior maxilla was removed by Dr. W., St. Paul, Minn., May, 1901. Diseased part could not be entirely removed. Growth continued to increase rapidly. General condition became rapidly worse. He was given only a few weeks to live. Entire disappearance of the tumor under 101 injections of the mixed toxins of erysipelas and *Bacillus prodigiosus* by the local physician, 1901. Marked improvement was quickly noted and continued steadily. Result, complete recovery. Died six years later from acute nephritis. Microscopical examination confirmed by Professors William H. Welch of Johns Hopkins and James Ewing of Cornell.

CASE XXXIII.—*Round-celled sarcoma of the testis; acute traumatic malignancy.* M. M., male, twenty-eight years of age (February, 1900); driver; family history good. Four weeks ago patient fell astride a bar and injured right testicle, no swelling noticed prior to this time. Swelling appeared very quickly, almost immediately after injury, and did not disappear. After a week or two began to increase in size. Two weeks ago patient went to Bellevue out-patient department and was tapped for supposed hydrocele; nothing but blood was found. I first examined him one month after the injury, and found the right testicle enlarged to the size of an orange. Believed to be sarcoma; two days later I removed the whole testis and cord up as far as the internal ring. Tumor appeared in the abdominal region, causing death five months from time of injury.

CASE XXXIV.—*Sarcoma of the back; acute traumatic malignancy.* Mrs. L. G., thirty-five years of age (November, 1902). October, 1901, while stooping under a heavy table, she rose suddenly and struck her back against the bevelled edge of the table. It hurt her so much the next day that she could not bend over. Three weeks later she noticed a hard lump at exact point of injury. It was removed, operation January 22, 1902, three months from time of injury. Tumor continued to grow rapidly. Several operations performed without checking the growth. Patient died from recurrence in the original place, and in the groin, in the early part of 1904.

CASE XXXV.—*Sarcoma of the left groin and inguinal glands; acute traumatic malignancy.* E. C. B., male, age twenty-one years (March, 1909). Struck in the left groin by a lever, Janu-

ary 15, 1908. Swelling appeared in the region at exact site of injury one week later. Increased rapidly in size. No pain. No evidences of inflammation. Two weeks after injury, tumor removed by Dr. Carson, Springfield, Mass. Microscopical examination showed it to be round-celled sarcoma. Recurrence shortly afterwards, involving the inguinal and iliac glands. Toxins were used; entire disappearance of tumor. Patient well in 2½ years.

CASE XXXVI.—*Osteochondrosarcoma of the ilium* (*acute*). L. P., twenty-seven years old (Oct. 27, 1910). Fell while on roller-skates, November, 1906. A few days later noticed a swelling over the right ilium in the region of the injury. Greatly increased in size. October, 1910, four years later, whole ilium and upper portion of femur involved in enormous osteochondrosarcoma, measured 22 inches by 21.

CASE XXXVII.—*Sarcoma of the frontal sinus* (*acute*). W. J. C., male, age forty-one years (October, 1906). Three years ago was struck in the left frontal region by a piece of iron weighing 1½ lbs., falling from a distance of 4½ ft. This blow immediately caused a swelling over the left eye near the hair line. Swelling never entirely disappeared. One month later began to increase in size, and continued to grow steadily up to date of my first observation, October, 1906. One year after injury there was a bulging of the left eye. Physical examination at that time showed an extensive inoperable osteosarcoma originating in the frontal bone, probably the frontal sinus.

CASE XXXVIII.—*Lymphosarcoma of small intestine* (*acute*). Intra-abdominal sarcoma, result from associated trauma. P. G., male, age thirty-two years; family history good. Fell down elevator stairs April, 1901. He was unconscious. Had shooting pains in the abdomen immediately after injury. Perfectly well up to the time of injury. Noticed hard immovable mass in right groin two weeks later. Began to lose weight at this time. Exploratory operation six weeks after injury, by Dr. Weir, Roosevelt Hospital. Diagnosis, lymphosarcoma of the small intestine. When I examined him, June 21, 1901, less than a month later, tumor had increased greatly in size and had involved the abdominal wall extending from the umbilicus to Poupart's ligament.

CASE XXXIX.—*Medullary carcinoma of appendix, cæcum, and ilium.* Miss D., fifty years of age. In March, 1907, fell

and injured the right ilium; considerable pain followed shortly afterward, which gradually increased. First operation three months later; second operation (both by Dr. W. G. Young of Grand Rapids), Nov. 9, 1907. A portion of the tumor was microscopically examined and proved to be medullary carcinoma. Third operation done by myself in February, 1908; primary growth found to be in the cæcum and appendix.

CASE XL.—*Sarcoma of the breast* (*acute*). A. M., female, age thirty-one years (August, 1896); family history good. The patient had always been in perfect health until August, 1896, when she received a blow upon the right breast. A few days later she noticed a lump at exactly the site of injury. This grew rapidly, but it was not painful until November. In December, 1896, it became exceedingly painful and was growing very rapidly. She consulted a physician, who advised internal treatment. On February 8, 1897, I saw her in consultation with Dr. William T. Bull. At this time the entire right breast was occupied by a spheroidal tumor about the size of a large cocoanut, markedly protuberant, slightly fixed to the chest wall, not involving the axillary glands. The skin was thin and glossy, and of a deep purple color over the most protuberant parts. The tumor grew with enormous rapidity and soon began to slough. The patient died of exhaustion in April, 1897, or seven months after the receipt of injury.

CASE XLI.—*Sarcoma of the breast* (*acute*). M. M., female, age thirty-one years (February 6, 1897); unmarried; family history good. Struck her breast against an iron bracket while acting as a clerk in a dry-goods store. She noticed a swelling immediately after the injury, and this continued to increase in size. Five months later the tumor was removed by operation, recurrence quickly following; four months from the first, a second operation was performed. The patient died eighteen months after the injury, from a supposed recurrence in the brain, five operations having been performed in the mean-time. This case was operated upon by Dr. B. Gallaudet and Dr. W. T. Bull; it was not seen personally by myself.

CASE XLII.—*Osteosarcoma of the ribs* (*delayed*). G. V., sixty-two years of age (January 19, 1910); male. Family history, father died of sarcoma of the tibia. A year and a half ago while trimming hedges he fell upon the sharp point of shears which ran into the tenth rib on the left side about the mammillary

line, causing a fracture. There was marked ecchymosis over this area at the time. Last August a small portion of projecting rib was removed. Microscopical examination, negative. Three months ago he developed a large mass in the axillary line a little above the site of the injury, right over the contused area. Patient lost 10 lbs. in weight. Has increasing weakness and rapid heart action the last few weeks. Gets out of breath very easily. Slightly cachectic in appearance. No tumor. Pulse has been running about 120. Physical examination shows a slight bulging of the chest wall, from the nipple nearly down to the costal arch, with complete dulness over the area. Fluoroscopic examination is stated by the physician to have shown a dark mass the size of a fist in this region.

CASE XLIII.—*Small round-celled sarcoma of the back (acute)*. N. J., male, eight years of age. In the latter part of August, 1901, fell from stoop, striking upon his back. Two to three weeks later, mother noticed a swelling in the left scapular region (the point where he struck), which increased rapidly in size and was soft and fluctuating almost from the start. Four weeks thereafter he was referred to me by Dr. Polhemus of Nyack, N. Y. Physical examination showed a cystic swelling, the size of an orange, in the left scapular region; fluctuation well marked. Diagnosis of hæmatoma was rendered. Under ether an incision was made and a large amount of dark bluish fluid was removed with a trocar. Three weeks later the fluid returned, and there was evidence of a solid tumor in addition to the fluid. A second operation was performed under ether, and a new growth was found which, on microscopical examination by H. T. Brooks, Professor of Pathology, proved to be round-celled sarcoma. It was impossible, in view of the large area occupied by the tumor, to make a thorough removal. The patient was put upon the X-ray treatment shortly after the second operation. Under four months' treatment the growth had apparently disappeared. However, three weeks later it recurred and finally disappeared under the mixed toxins. The boy is perfectly well at present, nine years later.

CASE XLIV.—*Sarcoma of the femur, following fracture.* T. H. B., male, forty-five years of age; blacksmith. January 20, 1900, received a fracture of the lower third of the right femur, caused by the kick of a horse; produced no lesion of skin; good union apparently followed; treated by weights for six weeks.

with apparently good result. About eight weeks after the injury, noticed what seemed to be callus increasing in size; this continued to grow larger and soon became painful. Within six months it had become the size of a child's head; I performed amputation; it proved to be an osteosarcoma which had occurred at the exact site of the fracture.

CASE XLV.—*Sarcoma of tibia.* S. F., female, forty-six years of age; had a fall in December, 1909; tumor developed almost immediately afterward.

CASE XLVI.—*Sarcoma of the femur (acute).* C. L., female, thirteen years of age. Had a fall in June, 1906. She had a little pain afterward, but a swelling was not noticed until two weeks after the injury, when there was found a small tumor in the lower inner portion of the right femur just above the knee. On August 13, 1906, she was admitted to the Hospital for Ruptured and Crippled. At that time the lower third of the femur was much enlarged and the entire bone was involved by a periosteal growth. Exploratory operation showed it to be an osteosarcoma. Amputation below the trochanter was done a few days later by Dr. Royal Whitman. She was put upon the mixed toxins as soon as the wound had healed. The toxins were continued until January 15, 1907. She regained her normal weight and was well 3½ years after.[2]

CASE XLVII.—*Sarcoma of the tibia* (Jan. 29, 1908). T. L., male, aged eleven months. December 20, 1907, or five weeks ago, while the baby was nursing, a two-year-old child seized his right leg and nearly pulled him to the floor, twisting the leg but causing no external bruise. Three days later the mother noticed a swelling in the middle of the right leg apparently connected with the tibia. Three days later she consulted a physician, who stated that it amounted to nothing. Two to three days afterward, she again called a physician who, this time, said it was a sprain and applied a splint. December 30, the child was brought to the Hospital for Ruptured and Crippled and examined by Dr. H. L. Taylor, who put the leg up in a plaster cast and the mother was told to return in one week. At the end of the week the cast was re-applied and the child was sent to another hospital for admission, as an indoor patient. The mother was unable to

[2] I have just learned that she has just died of metastases which developed four years after operation.

get the child admitted for more than two weeks, during which time the swelling of the leg increased very rapidly, the inguinal glands also became much enlarged and, at the end of three weeks, extensive hemorrhages appeared in the right eye and a little later in the left eye.

The patient was brought to me on January 29, 1908, or five weeks after the receipt of the injury. Physical examination showed a tumor involving nearly all of the right tibia, apparently the fibula as well, reaching nearly from the ankle to the knee; skin was movable, but of a purplish color due to dilated veins. The glands in the groin were markedly enlarged; both eyes showed evidence of extensive hemorrhage into the surrounding tissues; sight not impaired; slight exophthalmus. The child's general condition was so bad that the mother did not think he would be able to stand the journey from Brooklyn. The child was immediately admitted to the Nursery and Child's Hospital and the toxins were begun in one-tenth minim doses, with no reaction until the third dose, which was followed by a very slight reaction. The child failed very rapidly and died February 2, 1908. Such minute doses of the toxins as were given, with practically no reaction, doubtless had little influence in hastening the death. No autopsy was permitted. In the absence of a microscopical examination, it is impossible to say absolutely that the trouble was sarcoma, but the clinical features and the absence of temperature or any symptoms pointing to inflammatory trouble make the diagnosis practically certain.

CASE XLVIII.—*Sarcoma of the humerus (delayed).* R. G. H., male, forty-six years old. Amputation of thigh for sarcoma of tibia. Six years later fell, striking his right shoulder against an iron bed. Four weeks thereafter he began to have pain in the region of the right deltoid; was treated for rheumatism for nearly a year, when a bony swelling became apparent, which gradually developed into an enormous osteosarcoma. This was removed by amputation of right shoulder-joint.

CASE XLIX.—*Sarcoma of fibula.* Mrs. R., thirty-four years of age. Kicked by a horse in the upper portion of the right fibula, thirteen years ago. Almost immediately afterward, there developed a small bony tumor which was regarded as an osteoma. There was very little increase in size for thirteen years. In the spring of 1910 it began to grow rapidly, and within a few months

became 4–5 inches in diameter. September 25, 1910, removal of entire fibula. The tumor proved to be a spindle-celled sarcoma.

CASE L.—*Osteosarcoma of left humerus.* I. H., male, eighteen years of age; bricklayer. Fell three stories, striking a glancing blow in the region of the right humerus. Pain set in four months later and swelling quickly followed. Operation; recurrence in other humerus.

CASE LI.—*Sarcoma of rectus muscle* (*acute*). J. O. C., eleven years of age, male. Received a blow upon the abdomen just above the umbilicus in the summer of 1909. Two to three weeks later noticed hard lump in the right rectus muscle, just above umbilicus. January, 1909, operation at the Hospital for Ruptured and Crippled. Microscopical examination by Dr. Jeffries, Pathologist of the hospital and Professor of Pathology at the N. Y. Polyclinic, showed it to be a mixed-celled sarcoma; the report stated " for quite a distance beyond the growth proper, the muscle is being invaded by the sarcoma cells which follow accurately all the ramifications of the areolar interstitium."

CASE LII.—*Sarcoma of clavicle.* W. F., male, thirty-eight years old. In December, 1905, while swinging from a trolley car, he grasped the rail with the left hand and received a severe sprain of shoulder. He immediately began to have severe pain over the inner third of the clavicle which, however, subsided somewhat under massage. One week later he noticed a bony lump in the clavicle, which increased rapidly in size. It proved to be a round-celled periosteal sarcoma.

CASE LIII.—*Sarcoma of right thigh* (*delayed*). Mrs. G., fifty-eight years of age (September, 1910). Three years ago struck her right thigh against corner of bedstead in the dark. A small lump developed 2–3 weeks later. There was very little change in size for two years, when she fell on a chair, badly bruising the tumor. It immediately became very painful and at once began to grow rapidly. Operation, but tumor recurred within three weeks.

CASE LIV.—*Sarcoma of the femur—trauma* (*delayed*). W. S., male, age sixteen years (January 8, 1910); family history negative. Always had strong vigorous health until September, 1909, when he was injured while playing football. After he had fallen, another boy fell upon him, injuring his left hip in the

region of the trochanter. He complained so much of it, that a physician was called in, but he found only a contusion. All evidences of this entirely disappeared, but in the following June, or nine months after the injury, he began to have so-called rheumatic pains in the region of the injured hip. He was treated for rheumatism until September, 1910, when he consulted Dr. Fraser of Philadelphia, who found an inoperable osteosarcoma of the femur at the site of the injury. At the present time, January, 1911, the patient's condition is hopeless.

CASE LV.—*Sarcoma of the femur; acute traumatic malignancy.* J. A., male, twelve years of age (January, 1907). Perfectly well until three weeks ago, while coming home from school was kicked by another boy, in the right side of the femur just above the knee. He came home crying and mother carefully examined him but found no swelling at this time. One week later he complained of having pain in the injured region. Mother again examined him and found a hard, irregular swelling, about three inches above the knee, not movable. This rapidly increased in size, and January, 1907, three weeks after injury, he was admitted to the Hospital for Ruptured and Crippled. Photograph then showed acute form of swelling. Physical examination showed a tumor of hard consistence, apparently periosteal, involving the right femur, beginning about 2 inches above the upper border of the patella and extending 4½ inches upwards. Mixed toxins were used and the tumor slightly diminished in size; amputation immediately followed. Local recurrence. Death resulted four months from date of injury. Here we have one of the most striking examples of acute traumatic malignancy, a definite history of a single trauma localized. Careful examination shows swelling to have developed one week after injury, running a most rapid course, and causing death within four months.

CASE LVI.—*Sarcoma of the femur; acute traumatic malignancy.* E. D., male, aged twelve years; family history negative. Personal history: always in good health up to September, 1906, when he fell from the limb of a tree about six feet high. Three weeks later he began to have pain in the right upper femur; this continued, slowly getting more severe, until October, when he consulted a physician who treated him for rheumatism. In

January, 1907, he noticed a swelling in the upper part of the right femur which increased very rapidly in size and there was marked deterioration in general health. I first saw the patient on the 28th of March, 1907. The tumor continued to increase rapidly in size and caused death a few months later.

CASE LVII.—*Sarcoma of the radius; trauma.* M. F., female, twenty-six years of age; family history negative. Several years ago fell and injured left wrist. In the spring of 1908 tripped and fell, injuring the same wrist. Examination by her family physician showed a fracture of the wrist. Two weeks later she went to the New York Hospital and X-ray examination showed disease of the bone, probably sarcoma. On May 1, an operation was performed by Drs. Pool and Stewart; a central sarcoma was found and curetted out on either side. On May 18, there was no evidence of union and amputation was advised, but refused. The patient then came under my care for the treatment with the mixed toxins. After six weeks' treatment perfect union had occurred and the patient was well one year later.

CASE LVIII.—*Sarcoma of the femur; acute traumatic malignancy.* Male, age thirty-five years (March, 1907); family history good. Kicked by a horse in the middle of the left thigh about six weeks ago. Patient admitted to Bellevue Hospital, February, 1907. Tumor developed in size very rapidly in a few days, occupying two-thirds of the thigh, apparently connected with the bone. The development of the tumor was so rapid that it was not regarded by the attending surgeons as sarcoma, until a portion was removed and microscopical examination showed it to be chondrosarcoma. Entire tumor had developed within six weeks.

### CASES OF CARCINOMA OF BREAST, ASSOCIATED WITH ANTECEDENT INJURY.

CASE LIX.—*Carcinoma of both breasts (acute).* E. D., single; thirty-three years of age; family history good. Always well up to 1899, when she was run into by a tandem bicycle and thrown violently forward upon the pavement, striking upon her chest and bruising both breasts. Two to three weeks after the injury she first noticed a small lump in the right breast, which slowly increased in size. Two years later a similar lump ap-

peared in the left breast. From this time on both tumors grew very rapidly. The patient was referred to me by Dr. W. H. Carmalt, of New Haven, in September, 1902, who regarded the case as inoperable. The tumor in the right breast was the size of two fists and ulcerated; that of the left breast, nearly as large. Removal of both breasts; proved to be carcinoma; recurred in spite of immediate X-ray treatment after operation and proved fatal within six months.

CASE LX.—*Carcinoma of the breast; trauma.* A. M., female; single; age fifty years (August, 1906); family history good. Fell and struck right breast on the corner of a dresser short time before appearance of tumor. Two or three weeks later noticed a small hard lump on same breast, site of injury. Six months later breast was removed by operation. Proved to be carcinoma. X-ray begun two weeks after operation, continued for forty-five consecutive days. Seven months later whole right breast invaded with rapid growing, infiltrating carcinoma.

CASE LXI.—*Carcinoma of breast; acute traumatic malignancy.* M. M., female; age forty-six years (April 23, 1904). May, 1903, was struck in left breast by a baseball, thrown 100 ft. Caused a bruise, but noticed no tumor until five months later in exact region of injury, a small hard lump appeared. Grew with great rapidity. Examination April, 1904, showed entire breast involved in typical carcinoma. Tumor extensive; skin as well as pleural involvement.

CASE LXII.—*Carcinoma of the breast (trauma).* Mrs. A. M., thirty-seven years of age (October, 1901); family history good. Patient always well until a year ago when she was struck in the upper part of the left breast by a batted baseball, so severely that it knocked her down. Some pain felt in bruised area, left part of breast. One month later on exact site of injury, a hard lump appeared which continued to increase in size. October 20, 1901, I examined her and found the left breast of enormous size, almost entirely infiltrated, typical carcinoma. Tumor involving glands, skin, and pectoral region. Patient was hopelessly inoperable.

CASE LXIII.—*Carcinoma of breast (delayed).* Miss E. J. D., thirty-nine years of age; single. Had worn a plaster jacket or aluminum corset for lateral curvature of spine following infantile paralysis since she was five years of age. Four years

ago, cancer of the right breast developed; one year later, of the left breast.

CASE LXIV.—*Carcinoma of breast* (*delayed*). Mrs. J. W. C., forty-three years old (October, 1895). Two years ago struck by a tennis ball in left breast, causing her to faint. One year later noticed a small tumor at the exact point of injury, which proved to be carcinoma.

CASE LXV.—*Carcinoma of breast.* S. B., female, fifty-three years of age (January, 1896). Received a blow from a broom-handle in the right breast. Six months later a hard tumor developed at the exact point of injury, which proved to be a carcinoma.

CASE LXVI.—*Carcinoma of breast.* Mrs. D. P. C., fifty-two years of age (November, 1901). Kicked in the right breast by a child two years before.

CASE LXVII.—*Double simultaneous carcinoma of breast.* Mrs. N. A. B., forty-three years old (October, 1909). (Mother has carcinoma of breast at the same time, developing almost immediately after having fallen down the cellar stairs and injured the breast.) Seven years ago the patient was caught in the iron gate of an elevated train, severely bruising both breasts, causing them both to become black and blue. Six years later, noticed retraction of the nipple in the left breast with a slight exudation. Three weeks later, noticed a similar condition in the other breast. No distinct tumor noticed until September, 1908. I first saw the patient in May, 1909, when both breasts were extensively involved as well as the glands in both axillæ (medullary carcinoma).

CASE LXVIII.—*Carcinoma of the breast* (*delayed*). Mrs. L. P., fifty-nine years of age (March, 1906). Fell, striking right breast on the back of a chair when young woman. A small tumor developed immediately at the site of injury. This grew very slowly and remained practically quiescent until twelve years ago when it was removed by operation. It recurred ten years later and finally caused death.

CASE LXIX.—*Cancer of breast* (*delayed*). B. S., single, seventy years of age (1905); family history good. Perfectly well until August, 1905, when she struck the right breast against an iron bed post, causing a black and blue area. A few months later noticed a hard lump at the exact point of injury. Six

months later I removed her breast and axillary glands for carcinoma. The disease recurred within one year and caused death.

CASE LXX.—*Cancer of breast.* Mrs. W. D., fifty-nine years of age (September, 1902); family history negative. Ran against a hard object, striking upon the left breast, causing it to become black and blue. No lump was noticed until two months later. This increased rather rapidly in size and eight months later had reached the size of a goose-egg. Operation; recurrence; death.

CASE LXXI.—*Carcinoma of breast.* Mrs. H. C. L. (October, 1903); family history negative. Well until three years ago, when she was struck upon the upper part of the left breast by a boy, in play. No tumor noticed until two years later, but she stated it was exactly the same spot where the injury was received; grew slowly; first operation June, 1902; tumor pronounced adenoma; local recurrence 1903 with extension to other parts; typical carcinoma.

CASE LXXII.—*Carcinoma of the breast.* Mrs. C. S., colored, forty years of age (September, 1896); family history good. Received a blow on right breast three years ago. One and a half years later she noticed a lump on exact site of injury. This increased slowly since. Operation November 18, 1896; entire breast removed; recurrence.

CASE LXXIII.—*Carcinoma of the breast.* Mrs. C. S., widow, farmer's wife, sixty-three years of age (March, 1896); family history good. Three years ago injured her right breast while carrying a bundle of poles in her right arm. Six months later noticed small lump on the right breast, exact point of injury. I removed entire breast and axillary glands which were involved nearly up to the clavicle.

CASE LXXIV.—*Carcinoma of the breast* (*trauma*). Miss R. P., single, sixty-five years of age (August, 1903); family history good. Injured left breast falling against trolley car, 1902. One month later noticed depression in the skin. Two months later small tumor developed in this place. August, 1903, ten months from date of injury, examination showed tumor of the left breast with characteristic orange-peel appearance. Death followed recurrence one year later.

CASE LXXV.—*Carcinoma of the breast* (*trauma*). Mrs. K. R., age thirty-seven years (April, 1898); family history good.

Struck her right breast against a bedstead October, 1897. A few weeks later there began to be a reddish discharge from the nipple, followed by the appearance of a hard lump on site of injury. Examination, 1898, six months from time of injury, shows right breast the size of two fists. Skin infiltrated. Typical carcinoma.

CASE LXXVI.—*Carcinoma of the breast; acute traumatic malignancy.* Mrs. T., age forty-two (1895); family history good. 1892, suffered a severe blow on the left breast. A few weeks after a hard tumor was noticed in the region of injury. First operation, May, 1893, whole breast removed and examination showed growth to be scirrhous carcinoma. Recurrence, February, 1895. Beyond operation.

CASE LXXVII.—*Carcinoma of the breast.* Mrs. I. S., thirty-nine years of age (August, 1909); family history good. She ran against the corner of a shelf, injuring the right breast. Six months later a lump developed on exact point of injury. Operation two years later, recurrence followed within a few weeks. When seen by the writer, August, 1909, she had a large inoperable carcinoma of the left breast and axillary glands.

CASE LXXVIII.—*Carcinoma of the breast.* Mrs. A. R., thirty-nine years of age (December, 1902); family history good. Struck right breast against projecting nail in the wall two years ago, causing pain for two or three days, but no tumor appeared until one year later, when she noticed a small hard lump about the size of a hickory nut on exact point where injury had been received. This grew to be the size of a goose egg in about three months. Operation was performed and microscopical examination proved it to be carcinoma. Operation six months later and recurrence in four months, December, 1902.

CASE LXXIX.—*Cancer of breast (trauma).* Sister M., sixty years of age (October, 1898). February, 1908, suffered severe blow, right breast, from patient in the hospital. At once said that she felt sure she would get cancer from injury. No lump, however, was noticed until early in April, just two months after injury. This grew rapidly. September of same year, whole breast and axillary glands extensively involved. Condition hopeless.

CASE LXXX.—*Cancer of breast (trauma).* Mrs. M. McC., age fifty-seven years (January, 1905); family history good. Two years ago injured right breast by knocking against bedstead. About two months later, small nodule appeared at site of injury,

grew slowly. Breast removed a year later, October, 1904, by operation. Hopeless recurrence within three months of operation.

CASE LXXXI.—*Carcinoma of the breast resulting from continued irritation.* Mrs. K., thirty-three years of age (May, 1905); family history: uncle died of cancer of ribs as a result of fall. Patient stout, full bust. Two months prior to the development of the tumor she changed her habit of wearing a high corset to a low one, upper edge of which pressed against the breast and soon caused an irritation two inches to the right of the left nipple. Two months, beginning from date of wearing the corset, she noticed a small encapsulated nodule at the point of irritation about the size of a hazel-nut. At the end of four months Dr. Parham removed a small nodule which after microscopical examination was pronounced non-malignant. In spite of this, there appeared shortly after a rapidly increasing brawny infiltration, starting in the region of the tumor and extending over the whole anterior thorax, from the clavicle down to the costal arch and outwards beyond the axillary line. Glands in axilla became quickly involved. Within six months from time she first noticed tumor the right side of thorax anteriorly from the sternum to the midaxillary line, and from the clavicle nearly to the costal arch was occupied by an enormous infiltrating growth attached to the chest wall. Patient died a few weeks later.

CASE LXXXII.—*Carcinoma of breast (delayed).* Mrs. N. C., thirty-eight years old; family history good. In May, 1910, struck her right breast against a sharp corner of an ice-box. Is sure she had no lump in the breast previous to the injury and none after same, until three months later. She then noticed a small hard lump at the exact site of the injury. This was partly removed under cocaine at Bellevue Hospital and proved to be a colloid carcinoma. Entire breast and axillary glands removed by myself November 28, 1910, at the Rockefeller Hospital.

CASE LXXXIII.—*Cancer of the breast (acute).* Miss E. B. W., thirty years (1905); no heredity; no previous inflammation of breast; kicked in breast by a two-year-old child, causing a black and blue area; very painful for two days. One month later noticed a lump in exactly the same place. Eight months later consulted a physician who found a tumor the size of a hickory nut. Operation shortly afterward, proved it to be carcinoma; recurred and caused death in two and a half years from the time of the injury.

CASE LXXXIV.—*Cancer of the breast.* J. C. W. (February, 1907); family history good. In September, 1905, fell and struck right breast severely against the sharp corner of a wooden box. Breast became swollen and very painful. No tumor found at the time of the injury. The next day a swelling was noticed which slowly increased in size, and six months later the breast was removed by operation together with the axillary glands. It proved to be carcinoma; recurrence; death.

CASE LXXXV.—*Carcinoma of breast* (*hereditary*). Mrs. D. W., aged fifty-five years, gives following family history: Mother died of cancer of the stomach, the symptoms of which developed shortly after she was thrown from a carriage, injuring her abdomen, and her physician stated that the injury caused the tumor. An aunt died of internal cancer; one sister died of cancer of the breast at the age of thirty-eight years, the cancer developing very shortly after a blow; breast removed by Dr. Cheever, of Boston; recurred and proved fatal two years from the time of the injury. Another sister died of abdominal cancer which developed shortly after a blow upon the abdomen.

CASE LXXXVI.—*Carcinoma of male breast.* G. H., laborer, age sixty-four years (April, 1906). Family history: sister died of cancer of stomach. Injured left breast near nipple twelve years ago. Six months later noticed a small lump the size of a pea, hard and immovable, at exact site of injury. Slowly increased in size for six years. Plaster was applied 6 years ago. Tumor gradually increased in size. April 16, 1906, physical examination shows large typical carcinoma 2 x 3 inches in diameter, ulcerated. There are over entire extent several hard granular tumors in the axilla and one or two hard glands above the clavicle on the left side.

CASE LXXXVII.—*Carcinoma of the breast* (*acute*). Mrs. O. B., forty-five years of age (March, 1904), received a blow in the right breast from the elbow of a child, two years ago. Noticed a lump at the site of the injury a few weeks later.

CASE LXXXVIII.—*Carcinoma of the vagina.* S. F., age twenty-five years, married, one child, seven and a half months old. Patient states that she was badly torn at child-birth; began to have trouble shortly afterward. Four months later consulted a physician who stated she had a new growth in the vagina; had two slight operations. At my examination, October, 1908, seven and a half months from the time of child-birth, the entire

vagina was filled with an enormous carcinoma, infiltrating vagina and rectum. Condition hopeless.

CASE LXXXIX.—*Carcinoma of the breast.* Mrs. E. B., age thirty-nine years (February 26, 1907). Family history: mother died of cancer of the breast. Patient injured right breast in March, 1906, by running against the corner of a table. A lump appeared a few days afterward, at the exact site of injury. This grew rapidly in size and an operation was performed at Dr. Mayo's hospital on October 22, 1906. Disease returned in about three months locally and apparently in pleura and lung.

CASE XC.—*Carcinoma of the breast.* Mrs. W. P., age seventy years (1906). Family history: aunt, mother, brother and sister all died of cancer. Personal history: Six years ago received an injury to the right breast, caused by hitting against a wall. A month later she struck the same breast against an iron faucet. Very shortly after second injury, a lump was noticed at the exact site of injury. This grew rapidly in size, and she had it examined by Dr. Robert Abbe, who pronounced it carcinoma. She refused operation, and the tumor was finally removed by plaster. Patient examined by myself five years later, and found free from any recurrence. This case had no microscopical examination of the original tumor.

CASE XCI.—*Carcinoma of the breast.* Mrs. G. H. C., age fifty-four years (March, 1908); family history good. Husband had epithelioma of lip which existed ten years before operation was performed. Two and a half years ago, patient slipped on a rug and fell heavily to the floor, striking the right thumb against the right breast, so severely that it caused dislocation of the thumb. A few weeks (less than a month) afterward, a tumor developed at the upper and inner side of the breast at exact site of injury. Finally, six months after, breast and axillary glands were removed by a very extensive operation. A few weeks after operation there appeared a reddish colored thickening along the whole cicatrix accompanied by œdema of the arm. Examination, March, 1908, showed very extensive local recurrence with metastasis in the lung and pleura.

CASE XCII.—*Carcinoma of the breast.* A. C., age forty-three years (July, 1908); family history good. April 15, 1908, struck left breast a hard blow against a blunt piece of wood which caused no swelling at the time. About two or three weeks later she noticed a lump in the exact site of injury which grew

very rapidly. Physical examination, July 20, 1908, showed left breast occupied by an infiltrating tumor involving the whole central portion of the breast, very hard in consistence; skin adherent. No axillary glands involved. Clinical diagnosis of carcinoma beyond question.

CASE XCIII.—*Carcinoma of breast.* Mrs. E. T. A., age sixty-two years (October 21, 1895); married; no children. Five years ago fell and struck breast, causing a distinct bruise. One year later a tumor developed in site of injury, which rapidly increased in size till it was as large as an orange. Breast was removed, and proved to be carcinoma. I saw the patient October 21, 1895, with inoperable recurrent carcinoma. Operation and left breast removed. Microscopical examination proved it to be carcinoma of breast.

CASE XCIV.—*Carcinoma of breast.* Miss L. B., age forty-five years (1897). Mother died of cancer of breast. Four years ago received an injury by running against sharp corner of a banister and striking her breast. No tumor appeared at site of injury, until one year later. In 1897 I removed the breast and axillary glands. Tumor proved to be carcinoma. Extensive involvement of axillary glands. Part removed for microscopical examination proved to be carcinoma.

CASE XCV.—*Carcinoma of breast.* Mrs. N. F. B., age thirty-eight years (February 14, 1896); family history good. Four years ago, October 4, she fell and injured right breast. Tumor appeared a few weeks afterward. First operation 1894, partial excision of the breast by another surgeon; axillary glands not removed. Tumor recurred within the latter part of the year. Extensive involvement of axillary glands. I performed an operation February, 1895, but was unable to remove entire disease. Patient was put upon the mixed toxins of erysipelas and *Bacillus prodigiosus* with the hope of retarding the progress of disease. Died of abdominal metastasis.

## CONCLUSIONS.

A careful study of the evidence here presented, based upon over 1200 personal observations, justifies, I believe, the following conclusions:

1. Local trauma of any kind, from chronic irritation to a single local contusion, is not infrequently the direct exciting cause of malignant tumors of all types.

2. That a single local injury may cause a carcinoma as well as a sarcoma, is no longer open to speculation. The cases that I have submitted fulfil all the conditions necessary to establish a definite causal relationship between a single trauma and the development of a cancer.

3. This relationship in no way depends upon our ability to offer a scientific explanation of it; nor does it depend upon the acceptance of any one of the various hypotheses as to the etiology of cancer. It can be equally well explained whether we accept the extrinsic or intrinsic origin of malignant tumors.

4. Medicolegal side: The medicolegal aspect of this question is as yet in a most unsettled state. While we must admit that trauma often plays an important causative rôle in the formation of malignant tumors, this relationship must be clearly and definitely established according to principles and conditions very similar to, if not quite so exacting as, those laid down by Segond, before any legal liability can be admitted.

The following bibliography contains only a few of the more important references. For a more complete bibliography prior to 1894 cf. Löwenthal (*Arch. für klin. Chir.*, 1894–1895, Bd. xlix).

## BIBLIOGRAPHY.

Balthazar: Precis de medecine legale. Paris, 1906 (J. B. Bailliere, editeur).

Baumeister: Sur l'etiologie traumatique des tumeurs, dissertation de Wurtzbourg, 1905 (travail surtout consacre a l'etude des cheloides et de leur degenerscence cancereuse).

Becker: Les accidents du travail, 1903. Traduit d'apres la 4e edition allemande, par Gallez et Moreau. Bruxelles (H. Lamertin, editeur).

Berger: De l'influence des maladies constitutionnelles sur la marche des-lesions traumatiques. Th. d'agr. Paris, 1875.

Boas: Deutsche med. Wochen., 1897.

Carrel: Journal of the American Medical Assn., Nov. 12, 1910.

Chevassu: Tumeurs du testicule, Th. de Paris, 1905–1906.

Coley: Influence of Injury upon the Development of Sarcoma, ANNALS OF SURGERY, March, 1898.

Delbet (Pierre): Article Neoplasmes. In Traite de chirurgie de Le Dentu et P. Delbet, t. l., p. 393 et suivantes. Paris, 1896.

Dorson: Travail a consulter a propos de la degenerscence maligne des naevi, Th. Doct., Montpellier, 1899–1900.

Duplay et Cazin: Les tumeurs. Paris (Octave Doin, editeur).

Favet: Travail base sur un memoire d'Estlander et consacre a l'influence

du traumatisme sur le developpement des tumeurs malignes du sein chez la femme. Th. Doct., Paris, 1881.

Flitner: Travail contenant 11 observations de sarcomes des membres d'origine traumatique, d'apres l'auteur. Dissertation de Halle, 1896.

Forgue et Jeanbrau: Guide pratique du medecin dans les accidents du travail. Paris, 1905 (Masson, editeur).

Gerne, Didier and Jeanne of Rouen: Le Normandie Medicale, Dec. 15, 1906.

Grassmann: Origine traumatique des sarcomes du testicule. Dissertation de Munich, 1900.

Gross: Sarcoma of the Long Bones, American Journal of the Med. Sciences, 1879. (In the important statistics given by the author, traumatism is stated to have occurred 63 times in 144 cases of sarcoma.)

Hechinger: Sur l'origine traumatique des sarcomes. Dissertation de Munich, 1903.

Heldt: De l'origine traumatique des tumeurs, avec un cas de myelome traumatique. Dissertation de Munich, 1902.

Herzfeld: Trauma und Tumor Vortrag auf dem 6. Verbandstage deutscher Eisenbahnärtze zu Metz, 1904.

Kallionzis: Etude sur les relations des traumatismes et des contusions avec les neoplasmes. Athenes, 1898.

Kempf: Releve de 1767 tumeurs, observees a Göttingen (l'origine traumatique est vraisemblable pour 21 d'entre elles). Dissertation de Gottingen, 1900.

Kirchner: Ein Fall von Sarcom des Oberschenkels nebst statistischen Bemerkungen über Sarcom der Weichtheile. I. D. München., 1885.

Laskowitz: Carcinome du testicule apres un traumatisme. Dissertation de Munich, 1905.

Le Clerc: Contusions et neoplasmes. Th. Doct., Paris, 1883.

Lecene: Article Tumeurs. Extrait du Precis de Pathologie chirurgicale en preparation a la librairie Masson et Cie. Paris, 1907.

Lengnick: Deutsche Zeitschrift für Chirurgie, 1899, t. lii, p. 379 a 396.

Liebe: Travail contenant 119 observations de sarcomes survenus apres un traumatisme. Th. Doct., Strasbourg, 1881.

Lockwood: Lancet, Aug. 13, 1910.

Loewenstein: Rappaort etiologique entre un traumatisme unique et le sarcome. Beitrage zur klin. Chir., 1906, vol. xlviii, p. 780 a 824 (Etude d'ensemble complete et analyse de 3 observations recueillies dans la litterature).

Löwenthal: Origine traumatique des neoplasmes. Arch. für klin. Chir., 1894–1895, Bd. xlix (Travail base sur une statisque de 800 cas, dont 137 cancers du sein resultant, au dire des malades, d'un traumatisme anterieur).

Machol: Developpement de tumeurs a la suite d'accidents. Th. Doct., Strasbourg, 1900.

Menetrier: Article Tumeurs. In Traite de pathologie generale de Bouchard, t. iii, 2 partie, p. 723 et suivantes. Paris, 1900.

Moller: Travail consacre a l'etude des tumeurs et notamment des sar-

comes developpes sur le cal des fractures. Dissertation de Wurtzbourg, 1902.

Moser: Trauma und Carcinom. Aerzt. Sach. Zeit., 1903 (Cite par Olive). L'auteur s'est addresse a 12 corporations et leur a demande de lui indiquer tous les cas de carcinomes post-traumatiques observes par elles, pendant les 6 dernieres annees. Sur des milliers d'accidents, que ces corporations ont a indemniser annuellement, il n'a pu trouver que 15 fois le cancer.

Ollive et Le Meignen: Accidents du travail, medecine legale, jurisprudence, p. 190 a 197. Paris, 1904 (Rudeval, editeur).

Phelps: ANNALS OF SURGERY, May, 1910.

Potel (de Lille): Introduction a l'etude de la Chirurgie. Paris, 1907 (Doin, editeur).

Quenu: Article Tumeurs. Un Traite de Chirurgie de Duplay et Reclus, 2 edition, t. 1, p. 325 et suivantes. Paris, 1907.

Raffaele: Il medico ed il giuidice nella lege sugli infortuni del lavoro. Naples, 1901 (Nic. Jovene, editeur).

Ribbert: In wie weit können Neubildungen auf traumat. Einflüsse zuruckgefuhrt werden. Aerzt. Sach. Zeitung, 1898, nos. 19 and 20.

Roger: Introduction a l'etude de la medecine. 2e edition, p. 385. Paris, 1904.

Röpke: Habilitationsschrift, 1905. Monat. fur Unfallheilkunde, 1906, n. 3. p. 89.

Sand: La simulation et l'interpretation des accidents du travail. Bruxelles, 1907 (Lamertin, editeur).

Sandhövel: Ueber den Einfluss von Traumen auf die Entstehung maligner Tumoren. In.-Diss. Bonn., 1900.

Schöppler: Einmaliges Trauma and Carcinom, Zeitschrift f. Krebsforschung, Bd. x, Hft. 2, 1911.

Schwartz: Osteosarcome des membres. Th. d'Agr., Paris, 1880.

Segond: Transactions, Congress of French Surgeons, Oct., 1907.

Stern: Ueber die traumatische Enstehung der inneren Krankheiten. léna, 1900.

Thiem: Handbuch der Unfallerkrankungen. Stuttgart, 1898.

Thoinot: Les accidents du travail et les affections medicales d'origine traumatique. Paris, 1904 (Octave Doin, editeur).

Thomas: Le cancer. Th. Doct., Paris, 1905 (Revue générale tres complete).

Vibert: Medecine legale. 7 edition, Paris, 1907, p. 340.

Vibert: Les accidents du travail. Etude clinique et medicolegale des affections internes produites par ces accidents, Paris, 1906.

Werner Rave: Developpement des melanosarcomes sur les nævi, apres le traumatisme. Dissertation de Kiel, 1899. (Sur les 55 observations relevees par l'amteur, 19 portent la mention d'un traumatisme anterieur.)

Wild: Ein Beitrag zur Statistik der Sarcome. I. D. München, 1891.

Wurz: Beitrage zur klin. Chir., 1907, vol. xxvi, p. 567.

Ziegler: Ueber die Beziehungen der Traumen zu den malignen Geschwülsten, Münchn. med. Wochen., 1895, p. 621.

# ACUTE ULCER PERITONITIS IN TYPHOID FEVER.*

A PLEA FOR ITS EARLIER RECOGNITION

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IT is well established that patients suffering from so-called "intestinal perforation" in typhoid fever should be treated surgically. A surgeon's percentage of recoveries following operation for this condition will depend to a very great extent upon the number of hours that have elapsed between the time of the peritoneal invasion by the ulcer and the time when the patient is placed upon the operating table. This period will have to be shortened if the mortality records of this complication are to be improved.

It seems wise to put to ourselves frankly the question, Can we diagnose typhoid ulcer peritonitis at an earlier stage than is now the rule? If we feel that this cannot be done with the present means at our disposal, further attempts to shorten this period will have to be along executive rather than diagnostic lines. The writer believes, however, that in a great many cases an earlier diagnosis can and should be made, and that better methods should be adopted in order to give to the patient the full benefit of such an earlier diagnosis.

The general use of the word "perforation" in this connection has been extremely unfortunate, for it has unquestionably led the physician to disregard the changes which have preceded this event in his typhoid patients. Fixing his attention rather on the symptoms which may accompany or follow such an occurrence, which after all is often only

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the chance termination of an inflammatory condition which should have been recognized long before, he has in many cases allowed the preceding condition to progress undiagnosed, to the great detriment of his patients. Even in the fatal cases of ulcer peritonitis, a true perforation, such as one sees in gastric ulcer, does not invariably occur. When it does it is often only as a last nail driven into the patient's coffin. It has been preceded almost without exception by signs of the greatest diagnostic value.

From his operative experience the writer believes that in the cases where the ulcer is not confining itself to the mucous layer of the bowel the progressive changes that occur are usually as follows:

(*a*) *A distinct invasion of the muscular coat of the bowel.* While theoretically a slight invasion of the muscularis without any resultant affection of the overlying peritoneum is possible, it seems probable that this is a very rare occurrence.

As soon as the ulcer has gotten well into the muscularis and the inflammation has invaded its layers, (*b*) the overlying peritoneum becomes distinctly involved; we then have a *clinical peritonitis.*

This earliest peritonitis should be recognized at its onset. We should not wait until (*c*) *the muscularis has become necrotic* and the overlying peritoneum has become simply a thin film interposed between this necrotic tissue and the general peritoneal cavity; because by this time we shall have to diagnose in most cases (*d*) *a spreading peritonitis* either from the diffusion of the septic material in the necrotic area, or later from the additional dissemination of the contents of the bowel, which have filtered through the broken-down base of the ulcer.

This earliest peritonitis is seen to assume two forms:

(*a*) There is produced by the peritoneum in the vicinity of the ulcer a fluid serous exudate in varying amounts, a material of protective value possibly in a mild case that is not going on to a general peritonitis; yet mechanically harmful in the others, in that it restricts localization and tends

to float the coils of intestine apart, exposing large surfaces of peritoneum to the mechanical dissemination of the toxic material which is continually supplied to it as the ulcer progresses.

(*b*) The other type is the dry exudative type, in which the peritoneal surfaces in the vicinity of the ulcer are glued to the peritoneum over the ulcer, a process which helps mechanically to localize the infective material. The two types may be combined in varying degrees according to the kind of infection that is present.

The earliest stages of peritonitis in typhoid fever are recognizable in almost all cases by muscular rigidity, tenderness and pain, sometimes by muscular rigidity and tenderness alone. The physician's aim, therefore, should be to detect this first appearance of muscular abdominal rigidity, and thereby to establish a diagnosis of beginning peritonitis.

*Muscular Rigidity.*—From his experience in bedside instruction, both with under- and post-graduate medical students, the writer believes that this most important sign seldom receives proper attention. He is convinced that it should be recognized as the paramount sign in acute abdominal conditions, and that instructors should give to it first place in their teachings on the subject. The proper recognition of abdominal rigidity in its earliest stage may well mean life to the patient. It is true that two observers may differ as to the presence of muscular rigidity in a given case; this has been seen by the writer on several occasions. This is due either to a poor tactile power on the part of one of the examiners, or to a faulty method of examination, or to the improper posture of the patient during the examination, or to all three of these.

When speaking here of the lighter shades of muscular rigidity reference is made to the early appearance of this tonic-reflex-muscle-contraction, not to that intense degree of general muscular abdominal rigidity which follows it and which is found in late stages of a general diffused septic peritonitis from whatever cause—in the so-called "board-

like abdomen." There the rigidity present is grossly evident to any examiner the minute he puts his hand on the abdomen. It is the light shades of abdominal rigidity—those that appear at the inception of the peritoneal process—that we should be able to detect, and in order that their presence may not be overlooked the following precautions and methods should be remembered and observed:

*Position of the Patient, His Surroundings, etc.*—The patient should be lying out horizontally, with both knees drawn up. The position should be a comfortable one. The mouth should be slightly open, and the patient is told to breathe quietly. The arms should be at the side and extended; the head should be kept directly in the middle line and in a comfortable angle of flexion. The room in which the patient is examined should be warm, for a cool room may cause slight tremors in the abdominal muscles, which will prevent a satisfactory examination. The bladder should be empty.

*The Examiner.*—The examiner, whose hands have been warmed if necessary, stands on one side of the patient and first very quietly and very gently palpates with the flat of the hand those portions of the abdomen in which the patient does not complain of pain, tenderness, or discomfort, then gradually passes over to the affected parts. This gentle preliminary procedure affords to the examiner a rough idea of the general condition of the abdominal contents as to tumors, swellings, amount of adipose, points of tenderness, etc., and serves to allay a possible apprehension on the part of the patient. The next step is to determine the presence of rigidity in any of the abdominal muscles. This, in the writer's opinion, is best done with the most sensitive organs at our disposal—the finger-tips of the right hand. If the examiner is left handed, those of the left hand should of course be used. The wrist and the finger-joints are all kept slightly flexed, and a succession of short but very delicate "pushes" is made with them over the muscle that is being tested. It requires hundreds of examinations, as a rule, for the beginner to acquire the ability to detect slight differences

in the amount of rigidity present in different muscles or in the various portions of the same muscle; but the acquisition of this power is well worth infinite pains and patience on his part. The two sets of muscles which should be tested with special care for rigidity in typhoid patients are the recti and the lateral abdominal muscles. Owing to the usual preponderance of the dangerous ulcers in those coils of small intestine that are commonly found in the right iliac fossa and right paraumbilical regions, the right rectus and right lateral muscles should receive first attention. Taking into account the normal differences in muscle tone between the three segments of the rectus muscle, a preponderance of rigidity in any one of the three sections of the right rectus over that found in the corresponding section of the left is first to be noted. Then a rigidity of the right lateral muscle layer is sought for as compared with the same layer on the left side.

*Abdominal Tenderness.*—Abdominal tenderness has been mentioned as one of the signs of beginning ulcer peritonitis. It is usually present at an early period, and is localized to the area where the rigidity is found; it may not be marked at first in the cases where a fluid exudate separates the peritoneal surfaces in the vicinity of the progressing ulcer, but even here its appearance is seldom delayed. We cannot, of course, expect to elicit this sign very clearly in the toxæmic and comatose cases. In testing for the presence of tenderness, light pressure only should be used, otherwise adhesions may be broken up and pus and fecal material forced through the base of the ulcer.

*Pain.*—As a rule pain does not precede but *follows a peritonitis.* Cases operated on shortly after the appearance of pain often reveal an acute peritonitis that has undoubtedly been under way for some time before the pain began; this fact has unquestionably been the cause of delay in diagnosing a beginning peritonitis. Writers on the subject of so-called "perforation" mention pain as the prominent symptom, and most of them seem to think that a preperforative stage can-

not be diagnosed because there may be no pain at such a time. It is the writer's opinion that a recognizable amount of muscular rigidity and tenderness is often present at an earlier period than pain in ulcer peritonitis, and it is this very period of earliest peritonitis that must be recognized, if the post-operative mortality records in this condition are to be improved.

*Dulness in the right flank,* which shifts on turning the patient on the left side, may be an early sign of such a peritonitis; the fluid being formed first in the right iliac fossa region, then gravitating towards the pelvis, and later spreading to the abdomen generally. This shifting dulness is a very valuable sign if present at an early period. A *rising blood-pressure* and a *rising leucocytosis* may be of help in a doubtful case. Both may be absent, however, in the early stage of a peritonitis.

### DIFFERENTIAL DIAGNOSIS.

Should rigidity of the paraumbilical part of the right rectus muscle be found, or of the lateral muscles just external to it, especially if it be associated with a tenderness which has not previously been present, a diagnosis of beginning peritonitis in the right iliac fossa is assumed.

A differential diagnosis is then to be considered between "*beginning typhoid ulcer peritonitis*" and "*beginning appendix peritonitis.*" Unless the patient's appendix has been removed this is sometimes difficult. Fortunately, however, such differential diagnosis is not usually of vital importance, because a typhoid appendicitis which has progressed to the extent that it is associated with peritonitis (peri-appendicitis) should instantly be followed by the removal of the appendix. Should there be doubt it is safer to act as though the condition were one of ulcer peritonitis.

The differential diagnosis between an acute ulcer peritonitis and a sudden and copious *intra-intestinal hemorrhage* in typhoid fever is usually an easy one. In intra-intestinal hemorrhage without an accompanying acute peritonitis, there

is no muscular rigidity. The patient may complain of pain, but often there is none at first. If the hemorrhage is at all extensive, there is apt to be a sudden drop in the temperature, with a marked elevation of the pulse-rate, and the patient's color becomes distinctly paler. It is very rare to have both acute peritonitis and hemorrhage occurring simultaneously, but a peritonitis will frequently occur a few days after a hemorrhage, from further progress of the ulcer. In the earliest stages of an acute ulcer peritonitis little or no change can be noted in the previous pulse-rate or in the temperature or respiration, but there is always some discoverable muscular rigidity, and usually some tenderness. If the patient is so comatose from a co-existent typhoid sepsis as to be unresponsive to the palpation of the abdomen, it will be difficult to judge the degree of tenderness present.

It is the writer's opinion that in a great many of the cases of intestinal hemorrhage in typhoid fever there coexists a certain amount of low-grade peritonitis, which may at any time suddenly take on the characteristics of an acute process when the ulcer from which the hemorrhage has occurred has increased in depth or in extent. A recognizable amount of muscular rigidity should be present when this event has taken place.

When, during typhoid fever, there occurs an *acute cholecystitis* which progresses until there is an affection of the peritoneal covering of the gall-bladder, rigidity of the overlying right rectus muscle in its upper third will be present, with tenderness over the gall-bladder region. If it is a primary attack and the stomach, transverse colon, or omentum has not as yet become agglutinated by peritoneal adhesions to the gall-bladder, there may be no mass to be felt. As the peritonitis extends, rigidity of the lateral abdominal muscles in the right iliocostal space will be easily recognizable. A peritonitis from a typhoid ulcer located either in the hepatic flexure or in the upper part of the ascending colon should, however, be kept in mind where rigidity in the right upper quadrant is encountered.

A *right lower lobe pneumonia* or a *right-sided pleurisy* will often be associated with rigidity of the upper part of the right rectus and of the right lateral (iliocostal) muscles. Careful thoracic auscultation should determine such a diagnosis. Diminished breathing may be the only sign at first.

An *extensive infarct or inflammation of the spleen* will be accompanied by rigidity of the left upper rectus and lateral iliocostal muscles and by local tenderness, imitating the *kidney infarcts and perinephritis* in this particular. So will peritonitis about a typhoid ulcer in the splenic flexure of the colon. If there is no blood or pus in the urine a positive differential diagnosis may not be easy.

A typhoid patient who has *fallen out of bed* may suffer a contusion of the abdominal muscles. In such a case coexisting contusions of the skin or subcutaneous ecchymoses over prominent bony points are likely to be present. If found they should make us suspicious of an occurrence of this kind.

A *hemorrhage into one of the abdominal muscles* may occur, associated with a degeneration of the muscular fibres (Zenker's degeneration). The localized hemorrhage usually presents a raised or softened area in the muscle, differing in this way from a condition of muscular rigidity.

Tenderness in the suprapubic region should direct our attention to the possibility of a *distended bladder.* If unable to pass a sufficient amount of urine, the patient should be catheterized. Muscular rigidity present after this in the lower segments of the recti should make us suspicious of a peritonitis, either from an ulcer situated in a pelvic loop of intestine (small or sigmoid) or from a pelvic appendix. In women a vaginal examination should be made to clear up possible uterine or adnexal disease. A rectal examination here may be of distinct help.

A *soft tympanites* occurring during typhoid fever should be carefully watched. If it becomes a *hard tympanites* the muscular rigidity then present will indicate that there coexists a certain amount of scattered peritonitis, probably

from multiple ulcers. The writer has seen this condition in several toxic cases where the toxæmia had so overwhelmed the patient that the existence of pain and the presence of tenderness could not be ascertained; operation had therefore not been suggested. The autopsy showed areas of peritonitis mostly in the right side of the abdomen, apparently from the ulcers. A *periostitis of one of the ribs* that form the lower costal border may be associated with some rigidity of the abdominal muscles attached to that rib. Here localized tenderness at first over the affected rib should make the diagnosis clear if later there should be swelling.

An acute attack of *renal or ureteral colic* may come on during the progress of a typhoid fever. The great rarity of this complication is probably due to the fact that the typhoid patient is usually quiet in bed and that existing calculi are therefore subjected to little or no jarring. During the acute period of the attack there is usually some rigidity of all of the muscles on the right side. The history of a previous attack and the presence of blood in the urine would be of help. A radiograph might confirm such a diagnosis.

A *peritonitis from a mesenteric gland* that is on the point of suppuration cannot usually be distinguished from a beginning ulcer peritonitis, for they may both be present in the same case from the same infection.

From the foregoing it will be seen how important becomes the determination of even the lightest form of muscular rigidity, and how valuable to the patient may be the examiner's ability to accurately locate such rigidity in one of the quadrants of the abdomen. Such a beginning peritonitis may not last as a moderate process for more than a few hours; its duration as such may even be shorter than this, hence abdominal examinations of all typhoid patients between the third and sixth week of their disease should be made by a *competent trained diagnostician* at intervals of a few hours if the existence of such a beginning peritonitis is to be discovered.

This may seem not to be a feasible procedure. Before

discussing its feasibility let us consider the conditions which usually surround typhoid patients at the present time in what is often regarded as an almost ideal place for them, namely the "typhoid ward" of any of the larger city hospitals. They are there under the supervision of an eminent attending physician with a picked staff of medical internes and a corps of energetic and experienced nurses.

During the hours from 8 A.M. to 8 P.M., such a ward will be visited once, possibly twice, by the attending physician, who will devote considerable time to the typhoid patients. At other times during these twelve hours there will probably be some one member of the interne staff coming and going in the ward a good part of the time, so that any change which he or a nurse may notice in the condition of any one of the typhoid patients will be immediately reported to the house physician, or to the next member of the interne staff if the house physician is otherwise occupied. The patient is then carefully examined.

If there has been a complaint of abdominal pain and the examination reveals a change in the patient's appearance, with marked muscular rigidity and tenderness, the house physician, suspecting so-called "perforation," is apt to seek a confirmation from his attending physician. If by good fortune he can be located and can leave his work and hurry to the hospital, the delay will probably not be a long one. If the diagnosis be confirmed and the same good fortune attend the location of one of the attending surgeons, the total delay may not amount to more than a few hours. There is apt to be greater delay than this, however, and it is a fact that operations on so-called "perforating cases" are seldom done in so short a time. Especially is this the case when the peritonitis has started at night.

At night the nursing staff is reduced and even if special nurses are in constant attendance on the typhoids a slight change in a patient's condition associated with a light degree of abdominal discomfort or pain is not so readily noticed as in the daytime. This is apt to cause a delay in securing

a visit of the medical interne on night duty. This is especially true between the hours of 12 M. and 7 A.M. By the time the attending physician has seen the patient and the surgeon has confirmed the latter's diagnosis and the patient is placed on the operating table, several valuable hours have probably been consumed. If we add to this the time that has elapsed between the beginning of the peritonitis and the first distinct complaint of abdominal pain on the part of the patient we shall often have a delay of at least six to eight hours before operative measures are instituted, and when the peritoneum is opened it is usually found full of pus.

What is the remedy for all this? First, a skilled *resident* (salaried?) *physician* with previous ample experience in a large general hospital; second, a skilled *resident* (salaried?) *surgeon* of equal surgical experience who can reach the bedside day or night in a few minutes; third, "a special night typhoid service," consisting of rounds made to all waking typhoid patients (both ward and private) every two hours, from 8 P.M. to 8 A.M. by those members of the interne staff who have had previous experience in diagnosing acute surgical abdominal diseases and who will therefore be on the lookout for the earliest evidences of muscular rigidity. In this way any waking typhoid who *on inquiry* complains of the least degree of discomfort in the abdomen may be carefully examined. If muscular rigidity or tenderness be present, the resident physician can immediately be notified and within a few minutes the resident house surgeon may also be at the bedside; if the condition be judged one of beginning acute ulcer peritonitis, another twenty minutes should be sufficient to have the operating room ready. In this way the operation may be undertaken by the resident surgeon within one or two hours from the time when the peritonitis has started. Consent to operation should be obtained and recorded on admission in every case where symptoms are present suggestive of typhoid fever. Delay is thus avoided at a time when every minute counts.

In outside practice what can be done along these lines?

It seems to the writer that in the case of well-to-do patients the practitioner will wisely secure the bedside attention of two recent hospital graduates, one for day duty (12 hours) and the other for night duty (12 hours), from the beginning of the third week of the disease. Under these circumstances the graduate who keeps constantly in mind the first signs of an ulcer peritonitis can, at the very first complaint on the part of the patient of any abdominal discomfort, examine the abdomen and if muscular rigidity be present summon the practitioner to confirm the diagnosis. The practitioner will have previously made out a list of the surgeons (probably three at least) who upon inquiry have expressed to him the likelihood that they will be available during these three or four weeks and within reach by telephone. He will then immediately call on one of these surgeons to confirm his diagnosis and to operate within the hour if such is the decision. In any of the larger cities this forestalling should be possible with such surroundings, and it seems probable that in this way an operation could usually be started within two hours of the first signs of peritonitis. In non-toxæmic cases the chances of such patients to recover from this complication should be at least 50 per cent.

In outside practice where few patients can afford such skilled attention, and especially in the country districts, it is doubtful whether the present mortality percentage in typhoid ulcer peritonitis can be much reduced, unless the nurse in charge be able to detect the early stages of abdominal rigidity. Without going into the general theme of instruction to nurses, the writer feels that they should have special instruction in this subject. Such a practical course could be included in the one on surgical emergencies. While their training does not aim to qualify them to make accurate differential diagnoses in acute abdominal diseases, still it is fair to presume that after such practical instruction they should be able to ascertain the presence of muscular rigidity and its location. The importance of this subject is so great that superintendents of training schools may well give it their earnest consideration.

It may, of course, occasionally happen that the practitioner will be making his daily visit during or a short time after the first appearance of such peritoneal change, and that a surgeon can reach the case soon afterwards, but this must inevitably be the exception. One would say, therefore, that the ideal place at the present time for a typhoid patient would be in the general or private wards of a large medical and surgical hospital, where such skilled attention as the writer has previously mentioned can be secured.

It has been estimated that so-called "typhoid perforation" has been the cause of 25,000 deaths annually in the United States.

### OPERATIVE CONSIDERATIONS.

Given the presence of a light degree of muscular rigidity and tenderness in the right iliac fossa or right paraumbilical region, are we justified in advising operation?

The writer believes that operation is here indicated for the following reasons: In most of the cases a beginning ulcer peritonitis will be found. If the more common variety, the fluid exudative type, be found, this can by properly placed drainage be either arrested or converted into the dry type. The relief of tension will favorably influence the inflammatory process about the ulcer or ulcers, stopping it entirely where it is of mild type (Case IX), or preventing the development of pus in the moderately severe cases (Case VIII) or helping to localize it in the more severe ones (Case VII), so that in the latter it will either discharge itself later through the drainage tract or be accessible for subsequent evacuation.

If the necrotic process be found to have already invaded the peritoneal layer over the ulcer, a covering over of this area by suture, with or without omental grafting as the case may be, will be in order; or simple drainage may be used.

Washing out the peritoneal cavity in this early period does not seem to be advisable. In those very rapidly progressing cases, however, which are fortunately of unusual occurrence, where the bowel contents have escaped at an early period

into the general peritoneal cavity from the giving way of the necrotic base of the ulcer, their removal by flushing is indicated. Here pelvic drainage also will usually be provided. If on opening the abdomen an acute appendicitis be found, an appendicectomy should immediately be done, but here also search should be made for ulcer peritonitis, for an associated secondary peri-appendicitis of a marked type, from extension, may well exist alongside of an ulcer peritonitis. Local or general anæsthesia will be used according to the operator's judgment. The assumption of Fowler's position after operation seems of distinct help. It is a noteworthy fact that a very large number of the non-toxic cases who have been subjected to an early exploratory operation for a "suspected perforation," and in whom peritonitis has been found but no perforation, have recovered. The writer's belief is that in many of these, even where no drainage was used, the opening of the peritoneal cavity with the necessary handling of the intestines either arrested the peritonitis or changed its type so that the local conditions about the ulcers were favorably influenced and perforation averted. In cases where there has been an intestinal hemorrhage the probability of a supervening peritonitis should constantly be kept in mind. Examinations in these cases should be made certainly as often as every two hours if the patients are awake, in order to discover the earliest appearance of muscular rigidity in the right iliac fossa. Should it appear, the advisability of doing an exploratory operation for the peritonitis should be very seriously considered. The writer is willing to go a little further and the suggestion is here made that such exploratory laparotomy may not only influence the peritonitis in a favorable manner, but by so doing secondarily hinder the further destruction of the blood-vessels in the ulcer base, and avert hemorrhage. While a recommendation of this kind would not seem to be justified unless there exists a very distinct amount of rigidity in the right iliac fossa, the presence of the latter would make the procedure seem eminently proper.

It is worthy of note that the cases who have had in-

testinal hemorrhages followed by ulcer peritonitis with or without perforation, and who have been operated upon and recovered, have rarely had any subsequent hemorrhages.

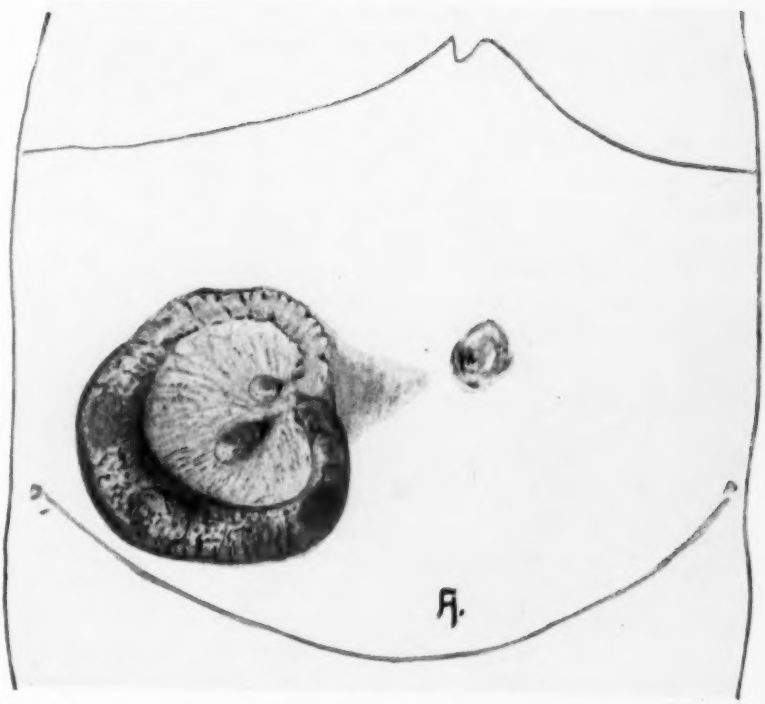
CASE IX.—S. D., colored, aged twenty, was admitted to the Presbyterian Hospital on Nov. 25, 1906, in about her fourth week of typhoid. She was apathetic and at times comatose. General tremor was marked, so much so that the taking of the pulse at the wrist was almost impossible—a markedly toxæmic case. About 12 M., November 28, 1906, her pulse which had been about 120 had become much more rapid. When the writer was called to see her about ten hours later he found that the heart-beats were 160 to the minute, that her abdomen was markedly rigid over the right iliac fossa, and that there was moderate rigidity in the right flank. There was slight dulness in both flanks. On account of her apathetic condition it was hard to judge the amount of tenderness that was present. A diagnosis was made of ulcer peritonitis and consent for operation then obtained from her husband. Operation was done on Nov. 29, 1906, at 12.30 P.M. On account of a suspicion of pneumonia cocaine was used. The mixed form of peritonitis was found, the peritoneum being œdematous in places with the fluid exudate, in places dry with an adhesive peritonitis; the appendix was normal except for its peritoneum. About one-half inch from the ileocæcal valve in the small intestine there was an indurated patch representing the site of an ulcer which had not gone on to perforation. The vessels over this patch and for some distance from it were tortuous, congested, and of a bright crimson color. Three similar areas were found further up in the small intestine, and about four inches apart. There were some large and inflamed mesenteric glands. The pelvic contents were normal. A gauze and rubber tissue cigarette drain was placed to the site of the ulcers. The operation was followed by distinct improvement in the quality of the pulse and in the patient's general condition. The abdominal rigidity entirely disappeared. Her toxæmia became still more marked, however, and about the third day after her operation the signs of a double pneumonia were distinct. She died. The autopsy showed that there was no perforation and that the peritonitis had subsided. There were only a few fine adhesions alongside of the drain.

In this case proper drainage was followed by the entire subsidence of the peritonitis. Had there not been so much toxæmia it is fair to presume that this patient would have recovered.

CASE VIII.—G. B., chauffeur, aged thirty-nine, was admitted to the Presbyterian Hospital, on Oct. 29, 1906. On Nov. 8 and 9, the patient being in about the third week of his typhoid, several hemorrhages had occurred. Thirteen ounces of blood were passed. About eight o'clock the next morning, he complained of some discomfort, followed by pain, in the epigastrium. This shifted in the course of the hour to the right iliac fossa. He was seen by the writer about an hour later, when distinct abdominal rigidity was found all over the right side; there was also some rigidity on the left side. The paraumbilical portion of the right rectus exhibited the greatest rigidity. Tenderness in the right iliac fossa was just appreciable to the lightest form of pressure. There was shifting dulness in both flanks. The pulse was about 120 (there had been little change in it). A diagnosis was made of pre-perforative ulcer peritonitis and immediate operation advised. Laparotomy was done about one and one-half hours after the beginning of the abdominal pain. The abdominal cavity contained more than a pint of clear serum, most of it in the right iliac fossa. In the small intestine, about six inches from the ileocæcal valve, there was a thickened area, with crimson peritoneal surface, the site of an ulcer. The loops of intestine in the right iliac fossa were all congested, but no perforation was found; the appendix was normal. The mesenteric glands were enlarged and congested. A gauze and rubber tissue cigarette drain was placed to the ulcer site. The patient made an uneventful recovery.

This patient had more than a pint of free serum in his abdominal cavity from ulcer peritonitis about one and one-half hours after his first complaint of abdominal discomfort, and he had very marked abdominal rigidity by the time this discomfort had become actual pain. Appreciable rigidity had undoubtedly been present before this. Here also proper drainage was sufficient to effect a cure.

FIG. 1.




Peritonitis from perforated typhoid ulcer, in a "relapse" case. Period elapsing between development of symptoms and operation, about six hours. Loop of small intestine about one foot from ileocæcal valve, showing situation of ulcers; perforation of one; general congestion, firmness, dilatation of intestinal walls, and swelling of mesenteric glands. (Case VII.)

CASE VII.—E. G., aged thirteen, school girl, came to the Presbyterian Hospital suffering from a relapsing typhoid on January 5, 1906. For the following nine days she had run a fairly typical typhoid course. There had been some abdominal distention, but no rigidity had been noted. She had taken her baths and nourishment well. There had been a positive Widal reaction on January 11. On January 14, about 4 A.M. (the abdominal distention having become more marked during the night), she had had a severe chill and her temperature had risen to 104.6° F., her pulse-rate to 132, and she had complained of pain in the lower abdomen. This localized itself shortly in the right iliac fossa. The writer was called to see her about 9 A.M. (five hours after her chill). Her abdomen at that time was markedly rigid over all, the right rectus distinctly more so than the left. There was a free fluid wave across the abdomen. Extreme tenderness was present with marked distention. There was very little respiratory movement in the abdomen. A diagnosis was made of spreading peritonitis, probably from a perforating typhoid ulcer. Operation was undertaken in a few minutes. Free seropurulent fluid in large quantities was found in the general peritoneal cavity, with scattered particles of lymph. On one of the intestinal loops there were several patches which looked as if they were about to break down, and one patch which was perforating in the centre; from this fæces exuded when the loop was handled. A purse-string suture of silk was placed around this patch and over it a continuous Lembert. A high pillow was placed under the shoulders to allow the free fluid to gravitate into the pelvis, and a flushing of the pelvis was then carried out with hot salt solution. A long gauze and rubber tissue cigarette drain was placed to the bottom of the pelvis. Fowler's position was used for several days. The patient went on to complete recovery, the resulting fecal fistula closing in a few weeks.

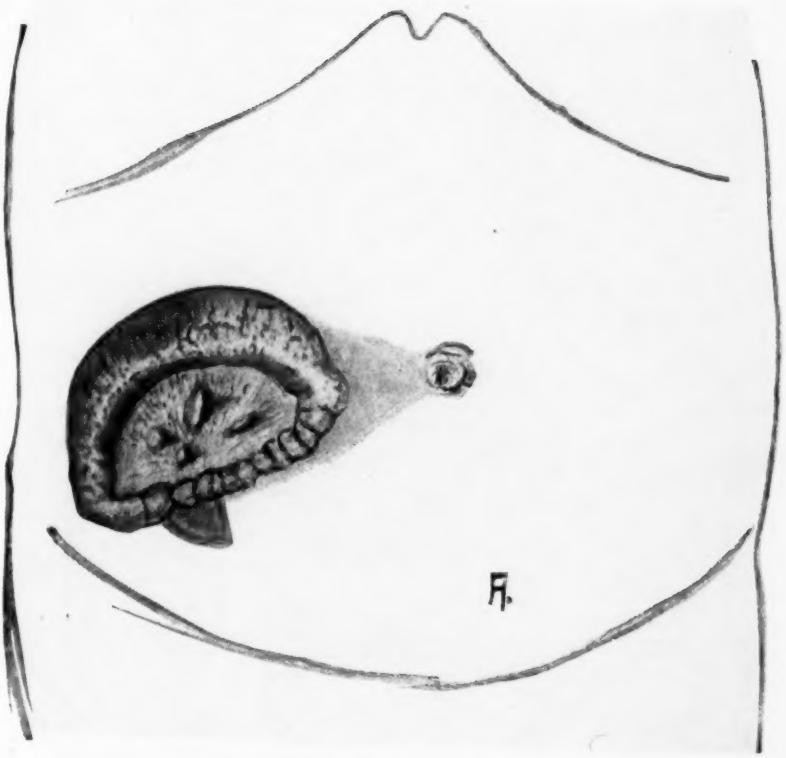
In this case the findings at operation justified the conclusion that some peritonitis had existed for several hours before the acute attack began. The chill and marked rise of temperature and of pulse-rate, with the pain in the lower abdomen, undoubtedly represented the change from a serous to a purulent exudate. The writer feels that this occurrence

might have been avoided by a prompt laparotomy done at the earliest appearance of abdominal rigidity.

CASE XI.—S. S., aged twenty-one, clerk? was admitted to the Presbyterian Hospital on Aug. 31, 1909, apparently in the end of his second week of typhoid. On Sept. 9, about 10 A.M., he complained of pain across his abdomen, and his appearance became somewhat changed. His temperature rose to 105° F. and his pulse-rate to 108. He vomited several times. A little after 4 P.M. he was seen by a surgeon who was reported to have been unable to detect any abdominal rigidity and on this account had advised against operation. The writer saw him within three-quarters of an hour from this time and found very marked muscular rigidity over the whole abdomen, with shifting dulness in the flanks and general tenderness. A diagnosis was made of an extensive peritonitis, probably from typhoid ulcers. The patient was operated upon about twenty minutes later. Free gas was found in the right iliac fossa, and the peritoneal cavity generally was filled with greenish-yellow ropy pus. On a loop of small intestine, about six inches from the ileocæcal valve, was found an indurated area, of about the size of a twenty-five cent piece, with a small perforation in its centre. The peritoneal surface of this area was greenish yellow in color, and on a neighboring coil of small intestine was seen a peritoneal plaque of the same size and color, representing apparently the part where this adjacent coil had been in contact with the ulcer area. Several Lembert sutures were applied, folding in the ulcer area. Drains were placed as follows: one of plain gauze to the right iliac fossa close to, but not touching, the line of Lembert sutures; two others to the bottom of the pelvis (one being a gauze and rubber tissue cigarette drain, the other a split rubber drainage tube which contained gauze). The patient had been placed with the shoulders elevated as soon as the peritoneal cavity was opened. After the operation Fowler's position was continued for several days. A small fecal fistula formed which soon closed. A slow but satisfactory recovery followed.

In this case operation was done about seven and one-half hours after the beginning of the acute symptoms. The writer is convinced that an appreciable amount of abdominal

FIG. 2.



Peritonitis from typhoid ulcer; end of third week of typhoid. Period elapsing between development of symptoms and operation, 1 hour, 30 minutes. Loop of small intestine about six inches from ileocæcal valve, showing site of underlying ulcer; general congestion, firmness, dilatation of intestinal walls, and swelling of mesenteric glands. (Case VIII.)

rigidity was present at the time of the acute onset, and probably for an hour or so before this. By an earlier operation the suppurative process might have been averted.

The following seven additional cases are here reported, making with the previous four a total of eleven operated upon by the writer for acute ulcer peritonitis in typhoid fever. Of these eleven, three recovered and eight died, a mortality per cent. of 73. If the three toxæmic cases (Cases II, IX, and X) are excluded from this list, it will then show eight cases with five deaths, a mortality percentage of 62.5. While almost all of the markedly toxæmic cases die of their toxæmia, whether operation be done or not, it does not seem fair to withhold operation from such of them as exhibit the slightest signs of ulcer peritonitis; for they may thus be helped to overcome this extra tax upon their resistance. Local anæsthesia would seem best for the operation in these cases, and the shock of simply opening the abdomen and inserting a proper drain to the right iliac fossa should be slight.

Case I.—C. H., clerk, aged twenty-four, was admitted to the Presbyterian Hospital on Oct. 5, 1900, with a diagnosis of typhoid fever. He ran an average typhoid course during the following five days. The writer was called to see this patient about 10 P.M., Oct. 11. He had then been suffering from abdominal symptoms for over twenty-four hours. They had consisted of continuous abdominal pain, hiccoughing, and distention. At 11 P.M., Oct. 11, his condition was as follows: He had marked abdominal rigidity, some distention, and his pulse was of poor quality. His general appearance was bad. A diagnosis was made of intestinal perforation with general septic peritonitis, and operation immediately undertaken. It revealed a general peritonitis with much purulent fluid and fibrinous flakes. There was free fecal material in the peritoneal cavity. About one foot from the ileocæcal valve was a perforation of the size of an ordinary lead-pencil, through which fæces were issuing. The ragged edges were trimmed hastily with scissors and two layers of Lembert sutures applied. There were a number of other ulcer patches which had not perforated. The peritoneal cavity was irrigated with several gallons of normal salt solution,

and drains placed to the pelvis. In spite of acute stimulation the patient died about five hours after the operation.

Case II.—G. McL., aged thirty-one, was admitted to the Presbyterian Hospital, on Aug. 15, 1903, with a ten-days history of malaise and of slight abdominal pain, chiefly in the right iliac fossa. He went through a fairly typical typhoid attack, and his temperature became normal on Sept. 6; he then had a relapse and in a few days became actively delirious and distinctly toxæmic. On Sept. 20, early in the morning he had a chill and his temperature rose to 106° F. His leucocytes were 4200. At 4 P.M. his abdomen had become very tense, and peritoneal friction râles were heard over its upper part. At 5 P.M. his leucocytes were 3500. At 8 P.M. his leucocytes were 3900 and the abdominal condition had become still more marked. At midnight his condition had become desperate. The writer was called in to see him at this time and found his abdomen markedly rigid over all, distended, and the signs of free fluid and gas. Diagnosis was made of a general septic peritonitis from perforated typhoid ulcer. Operation at midnight, Sept. 20, about eighteen hours from the beginning of his symptoms. The general peritoneal cavity was full of pus and purulent serum. There were no adhesions. About twelve inches from the ileocæcal valve there was a perforation in the small intestine, from which grayish fecal matter was issuing. There were several other patches about to break down. Lembert sutures were placed on all these and the peritoneal cavity irrigated with salt solution. Drainage was used. Intravenous infusion was done during the operation on account of the patient's desperate condition. He died the next day.

Case III.—W. K., aged twenty-one, designer, was admitted to the Presbyterian Hospital, on Sept. 17, 1904, with a history of fever and headache for about a week. He ran a typhoid course, responding well to his treatment. About 1 P.M., Sept. 22, he complained of severe abdominal pain, and his abdomen became very rigid, especially in the lower part. Later the rigidity and tenderness became still more marked, and he passed into a state of general collapse. The writer was called to see him about 6 P.M. His condition at that time was as follows: there was general abdominal rigidity, very marked tenderness over all, and a pulse of poor quality. His appearance was

alarming. A diagnosis was made of general peritonitis from perforated typhoid ulcer. At the operation which was done about five and three-quarter hours after his attack of severe pain, a general peritonitis was found with much turbid fluid and pus; there was a perforation in the small intestine about eighteen inches from the ileocæcal valve; there was some fibrinous exudate about the ulcer area. Two layers of Lembert sutures were placed, and the general peritoneal cavity was flushed with hot saline. Cigarette drainage was used. During the operation an intravenous infusion had to be resorted to. Active stimulation was continued and he rallied from the operation, but died in about six hours.

CASE IV.—M. M., aged nineteen, was admitted to the Presbyterian Hospital on Sept. 27, 1904, with a fairly typical typhoid history. He had in addition complained of some pain in the centre of his abdomen. On Sept. 29, at 9 P.M., he complained of pain in the right iliac fossa and there was tenderness there. At 11 P.M. his pain had increased. In the records there is a statement that there was slight rigidity at that time. At 12.10 A.M. there was sudden severe pain in the right iliac fossa and general tenderness and rigidity, with slight distention. Operation was decided upon, but consent was not obtained until about 4 A.M. Operation was done at 4.10 A.M., Sept. 30, about seven and a half hours after the beginning of his acute symptoms. Free brownish fluid with fecal odor was found in the peritoneal cavity. There was also some gas. About 12 inches from the ileocæcal valve there was a perforation in the small intestine about three-eighths of an inch in diameter. The peritoneum was irrigated with normal salt solution and two cigarette drains were inserted. On account of his desperate condition the patient received an intravenous infusion while on the operating table. Following the operation he rallied for a time, but the peritonitis did not subside and he died within 48 hours of the operation.

CASE V.—S. R., aged fourteen, school girl. Her previous history was negative except for an interval appendicectomy done several years before. She was seen by the writer on Oct. 5, 1905. She had then been running a typhoid course for forty-seven days with high temperatures and a high pulse-rate. Two weeks previously she had had a sudden attack in which

the pulse was increased in frequency and in which there was abdominal pain followed by distention; since then she had had a number of these attacks which lasted about six hours. Perforation had been considered, but her attending physician thought that the indications were not sufficiently plain for operation. About 8 P.M., Oct. 5, she had another attack decidedly more severe in character, and there developed general abdominal rigidity. The writer was sent for at 11 P.M. and reached her home in the country at 1 A.M. Her condition at that time was as follows: There was an anxious expression to the face, marked anæmia, and a pulse-rate of about 170, weak and irregular. The abdomen was distended. The right rectus muscle was rigid throughout, and there was extreme tenderness over the right iliac fossa. There was dulness in both flanks, and a suggestion of a fluid wave across the abdomen. Diagnosis was made of repeated perforations. Operation was done about 1.30 A.M. under cocaine anæsthesia. Scattered throughout the right side of the abdomen were a number of pockets containing pus which differed somewhat in color and consistency in the different pockets. In the region of the ileocæcal valve there was a large collection of pus; there was also much pus in the pelvis. It was hard to make out the distance of the various ulcers from the ileocæcal valve on account of the adhesions. Cigarette drains were introduced to the pelvis and to the right iliac fossa. The patient's condition improved somewhat after the operation, but later in the morning her heart action became still more rapid and she died within a few hours.

CASE VI.—J. P., aged twenty, was admitted to the Presbyterian Hospital on October 25, 1905, in the middle of a well-developed typhoid. From the time of admission until Oct. 24, the fever ran a rather irregular course, due perhaps to some small intestinal hemorrhages that occurred. On Oct. 24, about 1 A.M., the patient complained of a severe pain in the lower abdomen which lasted for a few minutes; this recurred at 3 A.M. At 8 A.M. the existence of a considerable amount of abdominal rigidity was noticed, associated with marked tenderness. Up to that time there had been little or no change in the temperature, pulse-rate, or respiration. The leucocyte count remained about the same. The writer was called to see the patient about 10 A.M. He was then in a very poor con-

dition, with intense rigidity of all the abdominal muscles. There was some dulness in both flanks; his pulse was of poor quality, and he was somewhat cyanotic. Operation was done at 10.30 A.M., at least nine and a half hours after the beginning of his acute symptoms. The peritoneal cavity was found full of grayish fluid, and there was a general peritonitis. Six ulcers were found in the small intestine within three feet of the ileo-cæcal valve, all of them about to perforate except one which had already perforated and from which pus and gas escaped. Circular sutures were placed, re-enforced by Lembert sutures, and the peritoneum flushed with salt solution. A cigarette drain was placed to the pelvis. The patient died shortly after the operation.

CASE X.—A. H., aged thirty. This patient was in his fourth week of a severe typhoid. His pulse-rate had been about 120, and his temperature about 104° F. He had been distinctly toxæmic from the start. His bronchitis had been severe and there had been marked congestion at the bases of both lungs. There had been three intestinal hemorrhages, one of about fourteen ounces, the other two smaller. He had rallied fairly well from these. On April 16, about 9 A.M., he had a chill and went into collapse, the pulse being almost imperceptible and the temperature 106.2° F. Marked distention set in. The writer was called about 10 A.M., and reached the bedside about 11, prepared to operate. The patient's condition at that time was as follows: He was comatose (but could be slightly roused), and cyanotic. His pulse-rate was about 140. It was soft and weak. There was abdominal rigidity over all, the muscles on the right side being distinctly more rigid than those on the left. The whole right side was dull. There was evidently some tenderness in the right iliac fossa. Operation was done a few minutes later under eucaine anæsthesia. A quart or more of turbid, foul-smelling fluid was found in the general cavity. About sixteen inches from the ileocæcal valve were two perforations, and adjoining these were several other circumscribed ulcer areas of dark color. Fecal matter was oozing through the perforations. There were many mesenteric glands in a condition of acute inflammation. The perforations were covered in by Lembert sutures and two cigarette drains were placed, one to the pelvis, the other to the right iliac fossa. The

patient stood his operation fairly well, but coma gradually deepened and he died about five o'clock the same afternoon.

A critical review of these cases brings out the fact that in the great majority of them a sufficient amount of importance had not been attached to the change in their abdominal condition. While a sudden attack of sharp pain, in the hospital cases, had invariably brought one of the members of the interne staff to the patient's bedside, the records show that a very careful search at that time for the slightest amount of muscular rigidity had not been carried out. This is perhaps too much to ask of them. The writer was once a member of this medical interne staff, and he now appreciates that at that time he was unquestionably unable in all cases to distinguish such differences. The importance of this subject was not sufficiently dwelt upon at that time in undergraduate instruction. The pathological conditions, however, which he then saw in the so-called "perforated" cases led him to the conclusion that it would be of the greatest value to the patient if the peritoneal changes, which had evidently been progressing in almost all cases for many hours before any acute symptoms had appeared, could be detected very shortly after their onset. By broad analogy with the affections of the appendix it seemed probable that a beginning peritonitis in typhoid fever could often be arrested by early operation if the diagnosis could be made with a reasonable amount of certainty.

In considering the various signs of beginning peritonitis, none seemed constant except that of muscular rigidity. The ability, therefore, to detect its presence at its very beginning seemed most important for the surgical diagnostician. Since that time the constantly increasing number of patients brought to the hospital suffering from acute abdominal conditions associated with varying degrees of peritonitis has afforded to the writer such experience as he then desired, and in his bedside instruction to the students he has constantly endeavored to impress upon them the paramount necessity of

familiarizing themselves at every opportunity with the various degrees of rigidity present in the different segments of the abdominal muscles in cases of peritonitis and of comparing these with the conditions found at operation.

## CONCLUSIONS.

If the distinctly toxæmic cases are excluded, an "early operation" for the others should give excellent results. This "early operation" should be one undertaken very soon after the appearance of the lightest recognizable shade of abdominal muscular rigidity.

The writer believes that this "early operation" is not usually suggested because the diagnostic value of abdominal rigidity at its first appearance is not appreciated, and that on this account a persistent search for it is not made from the time that the patient begins to suffer from abdominal discomfort. The records show that it is only recognized as a rule when marked pain is complained of, and unless other alarming symptoms are present that the case is unfortunately too often "watched" until the rigidity becomes general and a spreading peritonitis has become well established.

Enough evidence is at hand to justify the statement that an early exploratory operation exerts a distinctly beneficial influence, not only on the ulcers that may be about to break down but on others as well, thus preventing their further progress towards separate perforations, a condition recognized as almost invariably fatal (see Case V). Whatever may be the opinion held in regard to the advisability of peritoneal drainage for pus conditions originating in the female pelvis, or in cases of suppurative appendicitis, it seems that the coexisting typhoid poisoning should induce us here to follow that procedure which we believe will diminish peritoneal congestion, and by transforming the fluid variety of peritonitis about the ulcers into the adhesive one, bring about a protecting condition in their vicinity.

# THE RADICAL CURE OF FEMORAL HERNIA IN THE AGED.

BY PAUL M. PILCHER, M.D.,

OF BROOKLYN, N. Y.

In children, a femoral hernia is usually congenital; in adults, it is most frequently the result of sudden muscular effort, and may be termed an acute hernia. In the aged, it is commonly a hernia of slow development due to a gradual relaxation of the structures forming the femoral canal. In children and adults, the operation essential for the relief of this condition is necessarily more extensive, and may be undertaken without regard to the period of time consumed in carrying out the various steps of the operation, and without the other dangers which are present in all operations upon the aged. It has been observed that the simpler methods of closing the femoral canal which are usually sufficient to bring about a cure in the aged, are not so universally successful in younger subjects, and it is on this account that so many operations (numbering in the neighborhood of 75) have been devised for the relief of femoral hernia.

In the majority of cases of femoral hernia in the aged, the condition passes unnoticed until some accident occurs, which gives rise to pain or intestinal obstruction. Many times there is present an inguinal hernia on the same side, or a double inguinal hernia, a truss being used for the control of these but nothing done to hold in restraint the femoral defect.

As has already been stated no attention may be paid to the defect until some accident has occurred to the hernia, and in the majority of cases—60 to 70 per cent. at least—this accident consists of a strangulation of the intestine contained within the sac of the hernia. The problem presented to the surgeon is as follows:

He is called upon to treat a patient already infirm by reason of years; there has existed for some time an obstruction of the bowels; the patient during that time has been

unable to take food and is therefore weak from the want of it; he is also already suffering from the absorption of intestinal toxins which are the result of fermentation and putrefaction; the mind is somewhat obscured, and the complaints of the patient do not direct our attention to the site of the trouble; the cardiac function is impaired by reason of the patient's age and the autointoxication; the respiratory centres and lung tissue are in a condition favorable for the development of post-operative pneumonia and œdema of the lungs; the kidneys are congested and probably the seat of chronic degenerative changes; there is also complete reversion of all gastro-intestinal functions.

The usual history given by the patient is the following:

For the last five or six days there has been persistent nausea and vomiting, ascribed by the patient to an acute attack of indigestion; oftentimes the acute gastric symptoms subside, but there remains a continual nausea, the tongue is coated, there is loss of appetite, with attacks of vomiting once or twice a day, and enemata are administered without effect; the heart action at first is not especially rapid, and no concern is felt for the condition of the patient excepting that the bowels cannot be made to move, the patient cannot retain any nourishment, and there is a general lassitude and weakness unnatural to him. However, medical treatment does not improve the condition, and the vomiting gradually becomes fecal; finally the surgeon is called. His examination reveals a tumor characteristic of femoral hernia, tense, and not especially tender, a most striking symptom being the lack of pain in the region of the hernia. The diagnosis is easily made, and the question of operating upon the patient is considered.

If we give such a patient a general anæsthetic,—be it chloroform, ether, nitrous oxide, or ethyl chloride,—the primary result will be the same, that is, a depression of all the body functions; naturally, this is the effect least to be desired. The general anæsthetic weakens and increases the rapidity of the heart, irritates the lung tissue, irritates the kidneys, increases the tendency to vomiting, while the possibility of inspiratory pneumonia becomes very great on account of the fecal vomiting and the unconsciousness of the patient.

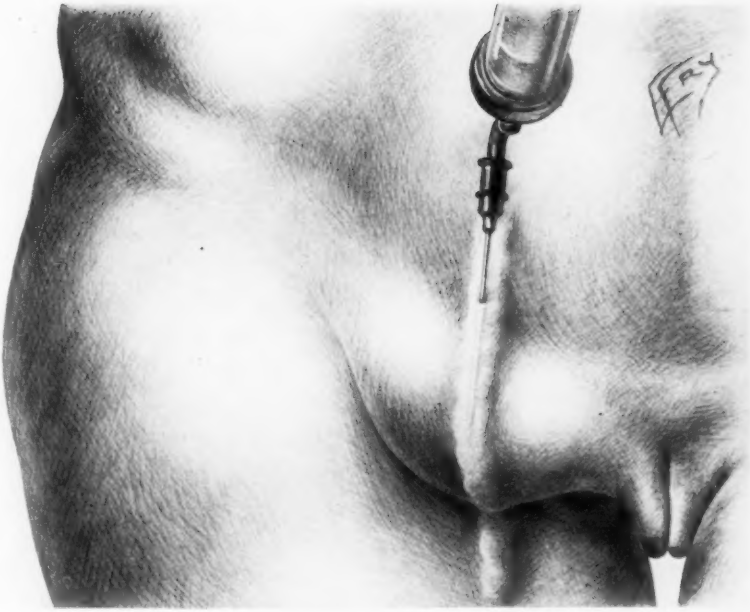
These dangers, however, can all be avoided by the use of local anæsthesia. Using a minimum amount of cocaine, it is no exaggeration to say that the operation can be performed without pain to the patient, his greatest shock being the thought of the operation, which may often be completed before he is aware of anything having been done. Instead of a weakening of the pulse, the heart usually becomes stronger and its action slower as the operation progresses; there is no unconsciousness of the patient, no vomiting following the operation, no suppression of urine, no œdema of the lungs, the patient remaining unhampered to fight the toxæmia.

*Technic of the Local Anæsthesia.*—In order to secure easily a sterile solution of cocaine of the required strength, all that is necessary is to boil in a proper receptacle one ounce of saline solution or one ounce of plain water; as the ebullition ceases, which it does at a temperature of 212° F., a tablet containing one grain of cocaine is dropped into the solution. The efficacy of the cocaine is not destroyed at a temperature below 212° F., but it will be seen that no pathogenic bacteria which might be contained in the cocaine powder could resist the action of such a temperature, and it has been actually demonstrated that a solution thus made is perfectly sterile; the strength of the solution is one-fifth of one per cent., and at least one ounce may be used without any danger to the patient.

Having prepared the field of operation, the line of incision is infiltrated with this solution of cocaine; the needle is passed into the skin but *not* beneath it, so that the injection is intracutaneous and *not* subcutaneous; the effect will be to raise a weal, as is shown in the accompanying drawing (Fig. 1). When this infiltration has been accomplished, the skin may be divided absolutely without the knowledge of the patient.

*Incision.*—The writer prefers the vertical incision, parallel to the femoral vessels and generally to the inner side, beginning one inch above Poupart's ligament and carried down as far as necessary over the hernial tumor; the incision varies from two to three inches in length. Many operators prefer an incision parallel to Poupart's ligament, slightly curved with the concavity upward, and extending on a line from a point two

FIG. 1.



Infiltrating the skin with cocaine solution along the line of incision.

FIG. 2.

Showing the structures concerned in repairing a femoral defect. Poupart's ligament lies anterior and superior; Gimbernat's ligament lies to the inner side of the canal and is covered by fibres of the iliac portion of the fascia lata; the horizontal ramus of the pubes covered by the origin of the pectineus muscle and its fascia lie behind the canal; and the sheath of the femoral vein lies to the outer side of the canal.

inches from the anterior spine of the ilium to the spine of the pubis. If the hernia is large and contains much gut and omentum, the incision must be changed to accommodate itself to the abnormal conditions. The skin and subcutaneous tissues are divided, the sac is separated gently from the surrounding tissues and freed as far as the femoral opening beneath Poupart's ligament; this may be accomplished painlessly without the use of any anæsthetic.

*Technic of the Operation.*—The hypertrophied adipose tissue which surrounds the sac is removed. The constriction of the sac usually takes place within the femoral canal formed by Poupart's ligament anteriorly, Gimbernat's ligament on the inner side, the pectineal fascia posteriorly, and the sheath of the femoral vessels externally (see Fig. 2). The sac of the hernia having been carefully isolated, it is drawn down and opened, and its contents noted. The femoral ring is carefully exposed, is injected with the cocaine solution, *and the constriction incised to allow drawing down of the strangulated gut, that it may be carefully examined before returning to the abdominal cavity.* One sees from the topographical anatomy that the points of incision should be anterior and internal in direction.

If there be any question as to the viability of the gut, the operation may be suspended at this point and the suspected gut kept warm by the aid of external agents for as long a time as it takes to satisfy the surgeon of its health or disease. The point of constriction of the gut should be carefully examined, because it is at this point that localized gangrene often occurs, which is accountable for a number of the deaths following the operation for the relief of this condition. If this be neglected and the gut returned to the abdominal cavity with a localized area of gangrene, the patient may seem to recover from the operation, passing small amounts of gas and fæces per rectum, but suddenly, in from four to seven days, there is collapse, the patient sinks rapidly and dies without warning. If the surgeon be sure that the gut is viable, the operation may proceed; the gut is returned to the abdominal cavity, the herniated omentum if hypertrophied or adherent, is removed, and the sac remains to be treated.

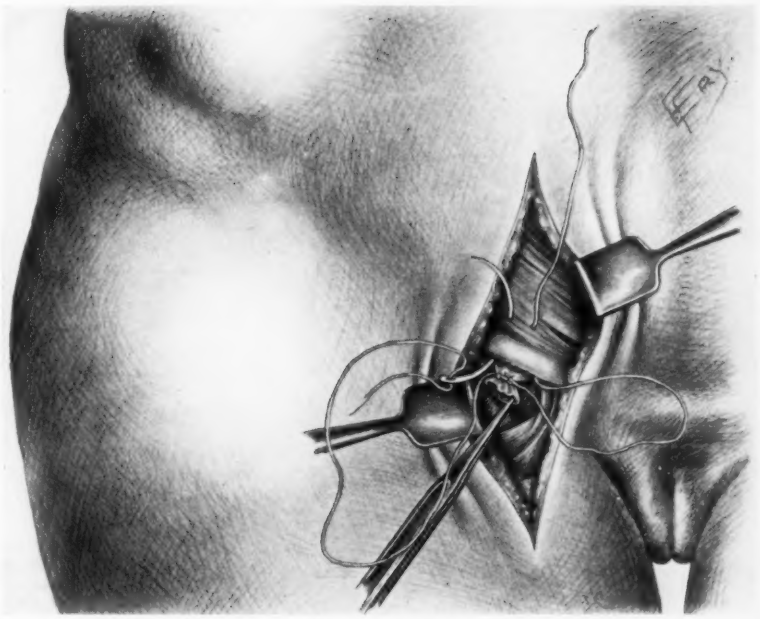
*Disposition of the Sac.*—The sac is drawn down as far as possible and its neck is transfixed with a heavy ligature of chromic gut or silk; the ligature is then carefully tied on one side of the sac and then on the other side, so that the ligature has transfixed the sac and is tied entirely around it, completely closing the peritoneal defect. The two ends of this ligature are then threaded on separate well-curved needles or aneurism needles, and the surface of the external oblique muscle above Poupart's ligament having been previously cleared, the stump of the sac is pushed up underneath Poupart's ligament with the forefinger of the left hand, and using this finger as a guide the needle is passed up and pushed through the overlying abdominal parietes above the level of the inguinal canal and the ligature is tied. In this way the peritoneal dimple at the inner femoral ring is obliterated, and the ring itself is blocked by a wad of cicatricial tissue (Fig. 3).

*Closure of the Femoral Canal.*—A single purse-string suture of silk or chromic gut is used for this purpose; the needle is first passed through Poupart's ligament near its attachment to the pubic spine; Gimbernat's ligament and the periosteum of the pubic bone are next included; the suture passes through the pectineal fascia and muscle, is carried across to include the sheath of the femoral vessels, and emerges again through Poupart's ligament; when the two ends of this suture are tied, the patency of the femoral canal is entirely obliterated[1] (Fig. 4).

If this method of suture be not feasible, the pectineal fascia and muscle are united to Poupart's ligament by interrupted sutures of chromic gut extending from the pubic spine to the sheath of the femoral vessels; this, however, takes a little more time. In some cases the hernia pushes down between Poupart's ligament and crosses over the sheath of the femoral vessels, producing a more extensive defect. In such a case, in addition to the purse-string suture as already described, it is necessary to attach Poupart's ligament to the muscular mass external to the femoral vessels, including the fascia lata (Fig. 5). In case the external inguinal

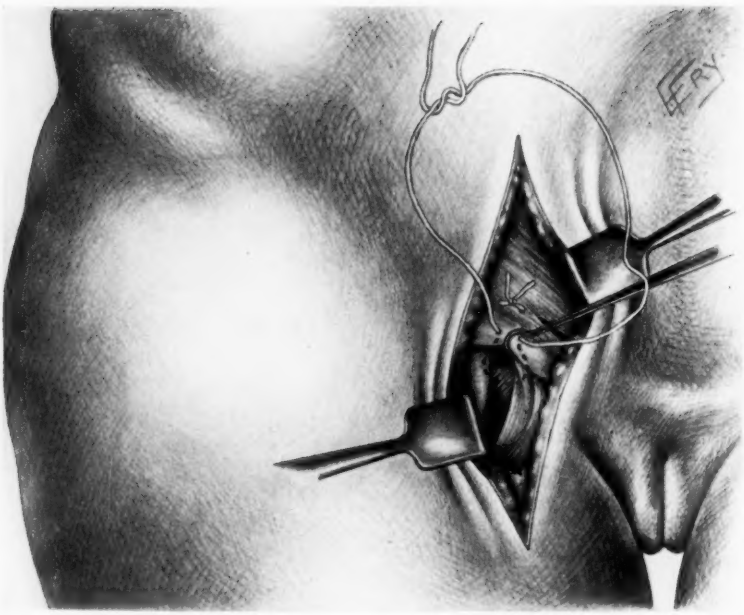
[1] Coley, ANNALS OF SURGERY, vol. xliv, 1906, p. 522.

FIG. 3.



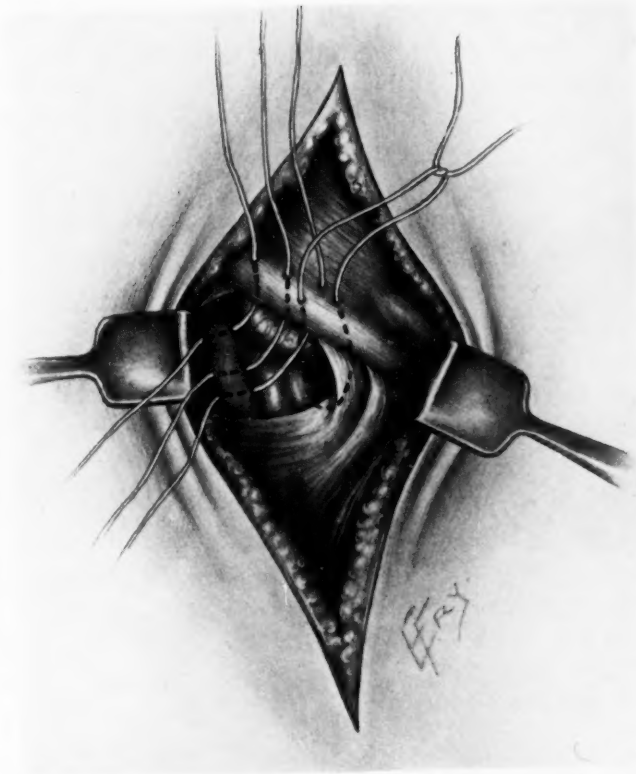
Disposition of the sac. After tying off the sac the two ends of the ligature are threaded on separate well-curved needles and the stump of the sac is drawn up and attached to the external oblique muscle as described on page 680.

FIG. 4.



Closure of the femoral defect by a single purse-string suture.

FIG. 5.



Showing an unusual form of femoral hernia described on page 680.

ring be enlarged, its pillars may be infiltrated with the cocaine solution and closed with two or three deep sutures of chromic gut. If an inguinal hernia be present, the incision may be carried up and a radical cure accomplished. If the patient's condition will not permit of the radical operation for the inguinal hernia, two or three sutures may be used to close the external inguinal ring, and one or two sutures may be used to narrow the inguinal canal without exposing the cord.

*Closure of the Wound.*—The wound is closed with interrupted silk sutures, without drainage.

It will then be seen that the procedure for the radical cure of femoral hernia in the aged is very simple, and consists of the following steps:

1. Intracutaneous injection of one-fifth per cent. solution of cocaine along the line of incision.

2. Incision, enucleation of the sac, and exposure of the femoral ring.

3. Opening the sac and inspection of the contents, incision of point of constriction, and return of intestines to abdominal cavity.

4. Transfixation and ligature of the neck of the sac with a single ligature, and fixation of the stump of the sac to the abdominal wall above the femoral ring.

5. Single purse-string suture uniting Poupart's ligament, Gimbernat's ligament, the pectineal muscle, and the sheath of the femoral vessels, obliterating the patency of femoral canal.

6. Closure of the wound.

The entire procedure is often accomplished with the use of about two drachms of one-fifth per cent. solution of cocaine, which contains about one-fourth grain of the cocaine. The patient is conscious, and is better able to fight the toxæmia. The procedure is very simple, needs few or no assistants, and can be done at the patient's home. Oftentimes no bleeding points need to be ligated, and the only foreign bodies are the ligature used to transfix the neck of the sac, the ligature closing the femoral canal, and the sutures closing the wound. It is therefore an operation peculiarly adapted to the aged, and results in a permanent cure of the hernia.

# ACUTE DIVERTICULITIS.

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OF TORONTO,

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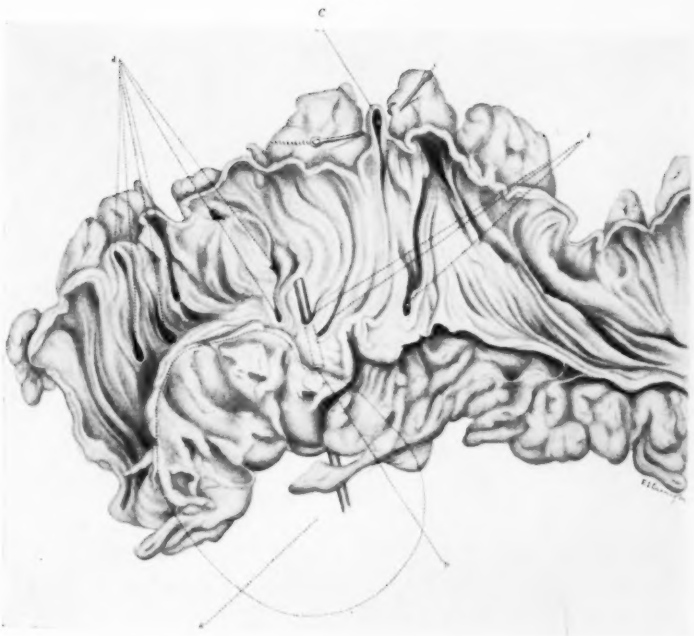
THE following case of acute diverticulitis, with perforation, occurred in a man aged sixty (M. O.), referred to me by Dr. G. W. Ross, by whom he was first seen on October 3, 1910. On this date he stated that in the previous June he had suffered from chronic constipation and "severe cramps." Ten days ago there was vomiting after food, and a few days later severe pain in the lower abdomen. On the previous evening the bowels were slightly moved by Kissingen water, but great pain resulted, with marked nausea after taking food of any description.

He complained of severe pain in the lower abdomen, most marked in the appendicular region, with rigidity of the right rectus and lower abdominal muscles, and rigidity and tenderness of the hypogastrium. On the following day the temperature was 99° to 101°, the pulse-rate below 100, and the leucocyte count 23,000. Most of the pain and tenderness were now referred to the hypogastrium and left iliac region, where a definite mass could be felt, the slightest movement of the abdomen causing severe pain. Urine contained albumin. Abdomen distended.

An incision was made in the middle line, and a large inflammatory mass found, extending from the middle line towards the left iliac region. The small intestines and omentum were matted together, and on insinuating the finger between the adhesions an abscess was opened and about two ounces of thick pus let out, and a drainage tube inserted. The sigmoid flexure could be felt forming the outer boundary of the abscess cavity. The appendix was sought for and found to be slightly inflamed, and was removed, as on account of the early history it was thought to be the beginning of the trouble. However, it was now quite clear that the disease originated in the sigmoid, and that we were dealing with a case of acute diverticulitis.

The patient became still more markedly distended after the operation, and we were unable to get the bowels to move. About thirty hours later the wound was opened up, the first part of distended bowel presenting drawn out, and a Paul's tube tied

FIG. 1.




Section of sigmoid opened, showing a number of diverticuli. *a*, abscess cavity outside sigmoid; *b*, a glass rod inserted through perforated diverticulum and into abscess cavity; *c*, enterolith in sigmoid; *d*, a number of diverticuli.

in. This, however, was not sufficient to relieve him, and he succumbed in twenty-four hours. An autopsy was performed by Dr. O. R. Mabee, who reports as follows:

The coils of small intestine were loosely adherent to the abdominal wound by fibrinous adhesions, and were covered by a fibrinous exudate and loosely adherent to one another. The Paul's tube was inserted into one of these coils, being held by sutures. There was an abscess cavity in the region of the sigmoid flexure four to six centimetres in diameter, and its outer and posterior walls were formed by the sigmoid and sigmoid mesocolon. The latter was covered by a thick fibrinous and partly organized exudate, and swollen and indurated. The inner and anterior walls were formed by the adjacent loops of small intestine.

On examination of the sigmoid after longitudinal section, *seventeen pouch-like projections were observed bulging into the mesocolon, and measuring from 2 to 5 mm. in diameter and 1 cm. in depth. A probe was passed through one of these from within the bowel into the abscess cavity.* Their walls were thin and apparently contained no muscle. Several of them contained hard fecal concretions and their walls were congested.

On microscopical section through the diverticuli their walls were seen to be composed of the mucosa, the submucosa, and the serosa. The tubular glands of the mucous membrane were fewer in number than normal, their lumina dilated, and their epithelium showed degenerative changes. The submucosa was infiltrated by moderate numbers of polymorphonuclear leucocytes, and a fairly large number of small mononuclear lymphocytes and eosinophiles. This inflammatory process at the base of the diverticuli extended for a short distance into the adjacent muscle.

*Anatomical Diagnosis.*—Multiple diverticuli of the sigmoid, perisigmoidal abscess, general peritonitis, and acute and chronic diverticulitis.

The accompanying drawing shows the condition very well. The probe passed through diverticulum, which had perforated.

Whilst operating upon a patient recently (Mrs. W., aged thirty-six), who had dense intestinal adhesions in the lower abdomen and pelvis, causing a very severe degree of chronic obstruction, I found a number of diverticuli of the small intestine above the obstruction. These diverticuli extended into the mesentery, and varied in size from that of a hazelnut to that of an almond. Altogether some twelve or fifteen were met with, situated at varying intervals of from four to eight inches apart. They were flask-shaped and empty, and it was quite clear that they were due to pressure from within the bowel, brought about by obstruction. They looked like hernial protrusions of the mucous coat through the muscular coat, with a very small aperture into the intestine.

In 1878 Chiari,[1] who examined 800 cases postmortem, found great variability in the depth of the lacunæ Morgagni, sometimes amounting to diverticuli, and in five cases a fistula was continuous with these. He considered these diverticuli due to pressure from within the bowel, similar to pressure diverticuli of the pharynx.

Graser [2] called attention to diverticuli of the large intestine due to deficiency of the muscular wall, owing to chronic congestion of the mesenteric vessels, and to diverticuli of the sigmoid causing inflammatory neoplasms.

Graser's diverticuli may occur in any part of the small or large intestine, and are congenital or acquired, the latter form being most common in the large bowel. They occur mainly in rows, at the sides of the gut or close to the mesenteric attachment, the commonest site being the appendices epiploicæ, and they may be the size of a hazelnut. When small they are semiglobular, but tend to become flask-shaped as they increase in size, and the aperture into the bowel is usually smaller than the maximum diameter of the diverticulum. They are not often found much above the middle of the descending colon, and increase in number and size from above downwards. They are usually full of fecal material.

They may be (1) of congenital origin, or (2) due to pathological causes affecting the intestinal wall. In 90 cases the average age was sixty, and about 65 per cent. are males. They are fairly common in connection with obesity. The normal sacculation of the colon is often exaggerated in constipation, and is sometimes found in association with these diverticuli. The longest retention of fecal matter is in this portion of the bowel.

Scheiber suggests muscular weakness or deficiency as the primary cause, Bier the "worked out" muscularis in senility in individuals who have been constipated or obese. The secondary pathological changes are atrophy of muscle fibres and of mucosal glands, difficulty in expulsion of fecal contents, tending to inspissation and concretions, and inflammatory changes in the sac wall due to bacteria. The direct results

are (1) tumor, (2) stenosis from cicatricial contraction and obstruction, (3) mimicry of carcinoma.

Neupert[3] reports a case in which there was the development of a chronic suppurative process from perforation of one or more of such diverticuli into the mesosigmoid, with much connective-tissue formation and cicatricial contraction of the mesentery. At the operation inoperable carcinoma was diagnosed.

In ANNALS OF SURGERY for August, 1910,[4] will be found a report of the microscopical examination of specimens from nineteen cases of intestinal diverticulitis, shown by Dr. J. A. Hartwell at a meeting of the New York Surgical Society.

Drs. Hartwell and Cecil[5] compare the pathology of diverticulitis with that of appendicitis. Thus there "may be (1) acute inflammation without perforation, but with peritonitis by extension; (2) acute inflammation with perforation, which may result in localized abscess, general peritonitis, or abnormal communication with a neighboring organ, such as the bladder; (3) chronic inflammation without marked lesions, with temporary exacerbations; (4) chronic inflammation with considerable thickening of the walls; (5) possible development of cancer. The differences are that gangrene of the appendix is common, whilst that of a diverticulum has perhaps never been heard of; inflammation of the appendix affects the mucosa, whilst the mucosa of a diverticulum remains normal until perforation is imminent."

Clinically it will be difficult to distinguish chronic diverticulitis. Acute diverticulitis may be suspected when there is pain, rigidity, and tenderness in the lower left quadrant of the abdomen. The absence of diarrhœa or melæna will help to distinguish this condition from syphilis, tuberculosis, or cancer.

BIBLIOGRAPHY.

[1] Chiari: Wiener med. jahrbuch., 1878.
[2] Graser: München. med. Wochens., 1899, 721.
[3] Neupert: Arch. f. klin. Chir., 1908, lxxxix, 399.
[4] Hartwell, J. A.: ANN. OF SURGERY, August, 1910, 262.
[5] Hartwell and Cecil: Amer. Journ. of Med. Sciences, August, 1910, p. 174.

# APPENDICOSTOMY TO SAFEGUARD THE EXCLUDED COLON IN LANE'S OPERATION FOR CHRONIC INTESTINAL STASIS.

BY A. E. ROCKEY, M.D.,

OF PORTLAND, OREGON.

To read Emil Metchnikoff's interesting book on "The Prolongation of Life" is to conceive a prejudice on the danger to health of harboring within the body a cesspool so vile as the colon. Follow this by reading Lane's monograph on the "Surgical Treatment of Chronic Constipation," and a ghostly procession of overlooked cases will pass in memory. The bad-breathed slaves of the anticonstipation pill, the Fletcherizers, the bran eaters, and the Carlsbad drinkers are there with the various ills produced by their slow poison.

I have one more charge to add to the indictment. Intestinal stasis may be an important factor in the causation of diabetes.

The colon is an economy dump whose function is to squeeze the last vestige of nutriment from the intestinal contents that are poured into it in a liquid state at the caput and in the cases under consideration only too often to be sluiced out at the other end by the enema syringe as a residue of hard lumps. That this function of absorption is a useful part of nutrition within proper limits is undoubtedly true. I am, however, quite in accord with those who believe that the dangers of its common perversion are vastly greater than we have suspected.

We know that the colon will absorb many quarts of normal salt solution, and this is representative of a useful function, but try ether vapor or an opium suppository and we quickly find that the colon is not discriminating and that deadly poisons are received with equal avidity. That pernicious substances are sometimes formed and reabsorbed within the body has been so often demonstrated that it is beyond dispute. I have a

number of times found a temporary glycosuria associated with intussusceptions. This disappeared promptly after operation. I have also seen it in severe obstipation. In one of the intussusception cases the condition represented perfectly a picture of diabetic coma.

In consultation I saw a girl of twenty-two who had rather suddenly become unconscious and had several convulsions. When I was called she was in profound coma. The catheterized urine contained sugar. Abdominal palpation revealed some distention and rather vaguely a mass on the left side. An immediate abdominal section revealed a long intussusception at the lower part of the ileum. It was resected and she made a slow and rather stormy recovery. The effects of the autointoxication were manifested by delirium, hallucinations, and great restlessness for more than a week.

Constipation so constantly present in diabetes has been regarded as a result. In the temporary glycosuria of obstruction, cause and effect are surely the other way. Why then may not the chronic autointoxication of habitual constipation be an important factor in the etiology of diabetes?

The occasional cases of malignant, tubercular, or inflammatory disease that have required resection of considerable portions of the colon have demonstrated to us that this apparently formidable operation may be safely done even under such adverse conditions.

In extreme cases of intestinal stasis with autointoxication, the colon may be resected as a primary operation. If I understand Lane rightly he admits a mortality of about 10 per cent. This is not an attractive constipation cure.

Fortunately he has given us the choice of a simpler method. By dividing the ileum near the cæcum, closing the cæcal end, and inserting the proximal end into the lower part of the sigmoid we may exclude the colon and cure the patient. Later in some cases he has found it necessary to remove the excluded colon, and while it is not commonly true he admits that hard substances may "form there." Most of us may believe that these may be fecal, backed up by a reverse peristalsis.

This was certainly true in the case of M. Mauclaire quoted by Metchnikoff.

After doing Lane's transplantation of the ileum several times, and I must admit always with benefit and never with any dire result as yet, but always with the possibility of fecal regurgitation in mind and the fear of a second and greater operation to urge upon a disappointed patient, it occurred to me that a simple appendicostomy would forever insure the safety of the excluded colon.

The first case in which I adopted this procedure was so typical in every way of the condition described by Lane that we may well use it as an illustration and quote it in detail.

CASE I.—Woman, age twenty-nine, tall, slender, married 12 years, two children 11 and 3 years of age; constipated since girlhood and for past four years in a very aggravated way; required constantly large doses of laxative, much troubled with bad breath, bad taste, bad dreams, cold hands and feet, a condition which was described as poor circulation. She had suffered much from abdominal pain, and had several attacks that were considered appendicitis. During the month previous to my first examination she had spent most of the time in bed, with pain on the left side, and came to examination with considerable discoloration of the skin on the left side of the abdomen produced by hot applications. At operation we found the condition typical of Lane's descriptions. There were numerous firm adhesions fastening the cæcum and the upper portion of the appendix well toward the outer wall. The same condition existed at the upper part of the sigmoid at the point where most of the recent pain had been felt. The transverse colon was elongated so that it reached well below the promontory of the sacrum. After severing the ileum and transplanting it into the lower part of the sigmoid, I detached the adhesions around the cæcum and appendix so that the caput of the colon might be brought well up against the abdominal wall. The operation was followed by an immediate amelioration of all symptoms and by regular daily evacuations of the bowels.

The method of doing appendicostomy which I adopted several years ago I described in a paper read before the Eastern

Oregon Medical Society, July 2, 1907. In doing it in association with this operation, the open abdomen admits of one slight but technically important variation in making incision for passing the appendix through the abdominal wall. As performed in conjunction with Lane's operation the procedure is as follows: Ligate the mesentery of the appendix with a strong catgut as for an appendectomy, being careful not to include the small artery running immediately along-side of the appendix. Leave the ends of the catgut six or eight inches long. Trim off the fat of the meso-appendix quite closely. The oozing points along the distal part may be disregarded. One or two points next the base of the appendix may be secured with very fine ligatures if they ooze much. If adhesions at the outer part of the cæcum are present in a manner to prevent easy approximation of the base of the appendix with the abdominal wall, they must be loosened before proceeding further with the operation.

Prepare for making the appendicostomy incision by grasping the right side of the abdominal wall in the hand, placing the thumb and index finger directly opposite each other at the outside of the rectus, thus bringing the thinner aponeurotic portion of the abdominal wall firmly in grasp at a place usually an inch or so below McBurney's point. Pass a narrow-bladed scalpel through the abdominal wall along-side of the finger from within outward. Fasten a long rather soft artery forceps to the scalpel blade on the outside, and draw the knife into the abdomen, pushing the forceps in with it. This manœuvre prevents the slipping of any of the tissue planes, and brings the forceps within the abdomen with the smallest possible incision. Grasp the tip of the loosened appendix and the ends of the catgut ligature on the mesentery with the forceps and draw out through the abdominal wall. Prepare a small roll of gauze about the size of the little finger and about three inches long, and fasten the tip of the appendix to the middle of the gauze with a stitch and roll it around the gauze until the caput of the cæcum is drawn up against the abdominal wall. Tie the catgut from the mesentery across the roll along-

side of the appendical curb, thus supporting the cæcum in position without tension on the appendix. The gauze is now bent in a horseshoe shape, and secured with a safety pin.

Under all ordinary circumstances this will finish this part of the operation. In case, however, the cæcum is much dilated and the appendix very small, it may be well to fasten the head of the cæcum to the peritoneum by a few accessory stitches.

The abdomen is now closed, and the wound is dressed in the usual manner. The part of the appendix where circulation

FIG. 1.

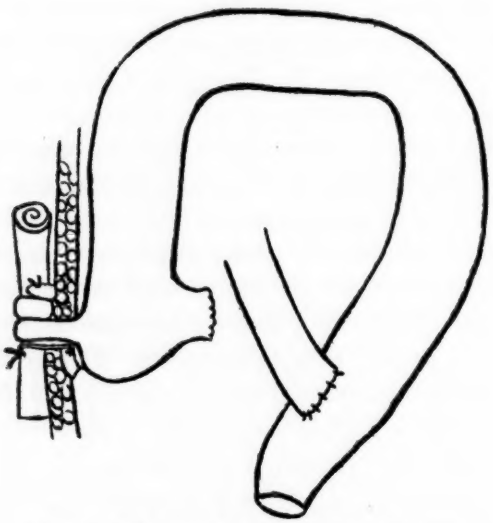


Diagram of the writer's method of appendicostomy.

is strangulated by being rolled around the gauze will shortly dry up in a flat ribbon. The proximal part, about one-third of an inch above the skin, retains vitality. The longer this is allowed to remain the firmer will be the adhesion and the less danger of the appendix drawing back below the skin after it is cut off. In my first operations I allowed it to remain about a week, but I prefer now to leave it alone for two weeks, and then at the time the wound is redressed and the stitches removed from the central incision I cut it off a little above the skin, and allow it to remain two or three weeks longer before

using it for irrigation. In cutting off the appendix care should be taken not to pull the gauze up enough to loosen the newly adherent appendix. Raise it only a little and slip the scissors under the gauze. This part of the operation is exceedingly important in order to secure a small duct-like opening which will not give trouble by leaking, and will remain free from any tendency to cicatricial contraction. Under no circumstances should the lumen of the appendix be dilated with a catheter or the integrity of the mucosa be endangered by pressure necrosis in wearing a tube. When done as described the appendectomy is not troublesome in any way. At most an occasional drop of mucus is secreted, and from this the underclothing may be protected by pinning a folded handkerchief to the inside of the shirt.

For irrigating the colon I use the milk tubes which are employed by dairymen and veterinary surgeons in drawing milk from the udders of cows. They may be found at all dealers where veterinary instruments are kept. With one of these tubes attached to a fountain syringe holding a gallon of water, the colon may be flushed with great ease.

I believe that the adoption of this simple addition to Lane's operation will in all cases obviate the necessity either for primary or secondary resection of the colon. This communication must be considered a preliminary report. To what extent flushing of the excluded colon will be required, only a long and large experience will determine. That in many cases it may never be necessary is believed. Appendicostomy is proposed as a safeguard to an operation whose value as yet has received scanty recognition, but which I believe to deserve permanent place among the important surgical procedures. That it will be abused I have no doubt, and that it will be done by the incompetent I fear. In my title I have retained Lane's second choice of terms, agreeing with him, however, that neither intestinal stasis nor constipation fully indicates the condition to which this operation is applicable.

# CHYLOUS CYSTS OF THE MESENTERY.

REPORT OF A CASE; OPERATION; RECOVERY.

BY W. H. AXTELL, M.D.,

OF BELLINGHAM, WASH.

I REPORT the following case, with references, for record because chylous cysts of the mesentery are of such infrequent occurrence that even standard text-books rarely mention them. I was unable to find mention of a single case in any of the standard works on surgery, the subject being simply alluded to in two instances. Park, in his surgery says that, "Chyle-cysts are rarely found in the mesentery and still less in other portions of the abdominal cavity."

Douglas, in mentioning mesenteric cysts in general in his "Surgical Diseases of the Abdomen," says that, "Angageur in 1886 found recorded only 19 mesenteric cysts; Moynihan in 1907 was able to gather only 113 cases; the latest statistics by Dowd makes reference to 145 cases. Tait in 2000 laparotomies did not meet with this condition; Spencer Wells found only two cases." In these cases of mesenteric cysts no mention at all is made of chylous cysts.

A list from the files of the Massachusetts General Hospital includes only 18 references. A letter from Grace W. Myers, Assistant Librarian of the Massachusetts General Hospital, says that the bibliography upon this subject is rather scarce.

CASE I.—F. S., thirty-two, German; married, five children. Patient had smallpox in 1902; he was always well until 1897, when, while attempting to turn a log with a canthook, with the handle resting on his shoulder, the weight of the log was suddenly thrown on the other end of the instrument, forcing him to the ground; he immediately complained of pain below the pit of the stomach. A few days subsequently he noticed a slight enlargement of the abdomen at the seat of pain. He was practically an invalid for a period of eighteen months, the swell-

FIG. 1.


Latero-anterior view showing globular form (half natural size)
*a*, continuation of glandular attachment.

FIG. 2.


Posterior view (half natural size). *a*, glandular attachment; *b*, portion of cyst along intestinal border between layers of mesentery. (Author's case.)

ing in the meantime gradually increasing. After eighteen months he slightly improved, and went to work as an apprentice cook. He remained comparatively well until about eighteen months ago, when he began to lose his appetite, lost weight, became anæmic; skin sallow; increasing difficulty in micturition; increasing and obstinate constipation; flatulence; increasing distress after eating; indigestion; pain in the pelvis; unable to sleep and increased weakness.

November 26, 1910, patient came to me for the relief of the obstinate constipation. Temperature normal; pulse 110; lungs normal; urine normal. Palpation of the abdomen revealed a large abdominal tumor, centrally located, extending from an inch above the umbilicus down into the pelvis behind the bladder; dulness on the left side extending from the left groin to the splenic flexure along the colon; the transverse and ascending colon were very much distended by gas.

Digital examination per rectum revealed besides an impacted bowel, a hard mass resting on the anterior wall of the rectum and the posterior wall of the bladder. By placing patient in the knee-chest position and using considerable force I was enabled to dislodge the tumor and push it out of the pelvis, thus removing the bladder or rectum from suspicion.

A sigmoidoscopic examination revealed the rectum and lower sigmoid impacted by hard scybalous balls; upon the removal of these the mucous membrane of the rectum was found suffused and inflamed; there was an acute flexure at the rectosigmoidal juncture, together with a considerable amount of thickening at the angulation. From the disengaging of the tumor and the cleansing of the bowel his general condition improved quite rapidly, gaining twelve pounds in three or four weeks.

The diagnosis of a cyst of the mesentery was made from the fact that the whole lower portion of the tumor was movable, the upper limit only being attached.

*Operation.*—January 11, 1911, with the assistance of my colleague, Dr. D. E. Biggs, laparotomy was performed. The tumor was brought into the incision in the abdomen, but being too large to extricate, it was aspirated until the tumor could be delivered. The fluid was milky white and, upon a subsequent miscroscopic examination, was found to be entirely chyle. The covering to the tumor was almost entirely from the inferior

layer of the mesentery of the upper part of the ileum near its juncture with the jejunum. The attachment was a little to the left of the spinal column. There was no particular difficulty in dissecting the cyst, although a portion of the glandular vessels was removed. The cyst contained two quarts, lacking five ounces. The accompanying drawings are self-explanatory and give a fair idea of the size and appearance of the tumor as it appeared filled with chyle.

*Subsequent history.*—The man left the hospital on the seventh day, apparently fully relieved of all the previous symptoms. However, the first two weeks after leaving the hospital he was practically unable to control the bowel movements or the bladder, and lost all that he had previously gained and several pounds besides; since then, however, by using appropriate abdominal supports, these difficulties have been overcome and he has gained rapidly; eats everything without distress; food well digested, bowel movements abundant and effective with no accompanying distress. At the present writing, March 3, 1911, the patient has returned to work and has gained all that he has lost, and says he feels better than he has felt for fifteen years.

Appended is a list of references to the literature on chylous cysts of the mesentery, which, I believe, contains a fairly accurate list of all the reported cases up to the present.

## REFERENCES.

### *Books.*

Klefstad-Sillonville: Kystes chyleux du mésentère, Paris, 1892.
Schvetz, J.: Chylangiome kystique du mésentère, Lausanne, 1904.

### *Periodicals.*

Beach, H. H. A.: Chylous Cyst of the Mesentery; Laparotomy; Recovery, Boston M. and S. J., 1898, cxxxix, 489.
Bramann, F.: Ueber Chyluscysten des Mesenteriums, Arch. f. klin. Chir., Berl., 1887, xxxv, 201–212.
Fawcett, J.: Chyle Cyst of Mesentery; Intestinal Obstruction, Tr. Path. Soc., Lond., 1901–2, liii, 406–408.
Fetherston, R. H.: A Case of Chyle Cyst of the Mesentery, Austral. M. J., Melbourne, 1890, n. s., xii, 475–479.
Floersheim, L.: Kyste chyleux du mésentère simulant une occlusion intestinale; autopsie, Gaz. d. hôp., Par., 1895, lxviii, 2–4.

Hoover, T. C.: Removal of a Chylous Cyst of the Mesentery, Tr. Ohio M. Soc., Toledo, 1895, i, 263–365.

Letulle, M.: Kyste chyleux du mésentère, Bull. et mém. Soc. anat. de Par., 1899, lxxiv, 521–525.

O'Connor, Chylous Cyst of Mesentery; Operation; Recovery, Brit. M. J., Lond., 1897, i, 391.

Rasch, A.: A Case of Large Chylous Cyst of the Mesentery, Tr. Obst. Soc. Lond. (1889), 1890, xxxi, 311–319.

Rodriguez: Kyste chyleux du mésentère, Bull. Soc. anat. de Par., 1891, lxvi, 661.

Schmidt, R.: Lymph-respective Chyluscyste im Mesenterium, Mitt. d. Gesellsch. f. inn. Med. u. Kinderh. in Wien, 1904, iii, 91–93.

Speckert, J.: Ein Fall von Chyluscyste, Arch. f. klin. Chir., Berl., 1904–5, 998–1033, 2 pl.

Wenning, W. H.: Chyle Cysts of the Mesentery, with Report of a Case, Cincin. Lancet-Clinic, 1894, n. s., xxxiii, 653, 664.

Brinsmade, W. B.: Chyle Cysts of the Mesentery, ANNALS OF SURGERY, Philadelphia, October, 1908.

Congdon, C. E.: Chylous Cyst of the Iliac Mesentery, Amer. Jour. of Obstet., November, 1909.

Porter, M. F.: Chylous Cysts of the Mesentery, ANNALS OF SURGERY, March, 1906.

# REMOVAL OF THE URETER WITH A TUBERCULOUS KIDNEY.*

BY GEO. ERETY SHOEMAKER, M.D.,

OF PHILADELPHIA,

Gynæcologist to the Presbyterian Hospital; Consulting Surgeon to the Woman's Hospital of Philadelphia.

AN Italian multipara, thirty-five years old, was admitted, November 4, 1910, to the Presbyterian Hospital. She had been well until five months before, when frequent urination began, with pain in the bladder and right abdomen. Pain became severe, with irregular fever and sweating.

Examination showed a rounded tender mass extending an inch below the level of the navel in the right inframammary line, confirmed by the X-ray, which showed no stone. Left kidney not palpable. In the vagina a firm cord began abruptly forward and to the right of the cervix, passed outward upward and backward until it disappeared behind the uterus. On the opposite side no corresponding cord was felt in the region of the other ureter end. Uterus of normal size but carried bodily to the right of the median line. Hæmoglobin 73 per cent., leucocytes 11,500. Cystoscope showed capillary injection of the bla der, no growth and no deep ulceration. The left ureteral opening was to the right of the median line, being carried over with the uterus by intrapelvic inflammation and subsequent contraction. It was a well formed slit with flexible lips, and spouted blue urine freely within 18 minutes of injection into the buttock of 20 c.c. of water in which was dissolved a tablet of indigo-carmin. Farther to the right of it was a dark red, granulating patch, in the centre of which rose an irregular, yellowish white mass resembling a pile of small worms. This mass proved to be made up of cheesy casts apparently coming from a concealed right ureter. No blue urine escaped with this cheesy detritus.

*Diagnosis.*—Dead right kidney, ureter involved, probably tuberculous.

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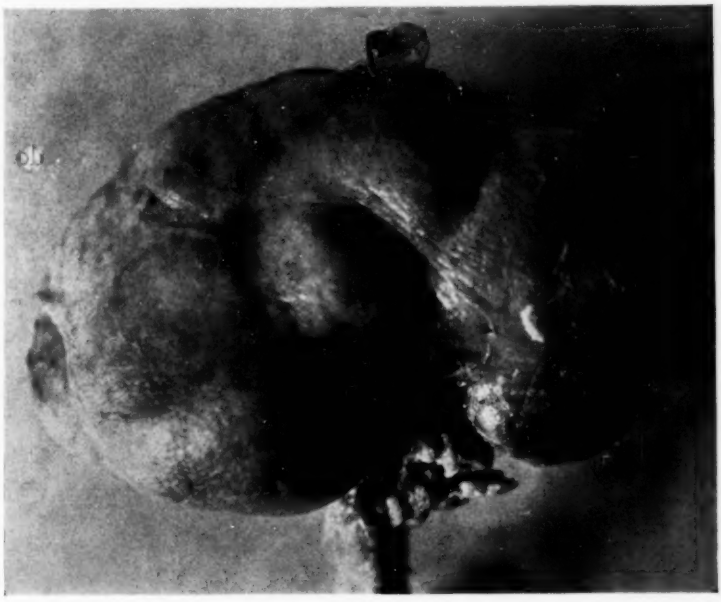
* Read before the Philadelphia Academy of Surgery, January 16, 1911.

FIG. 1.

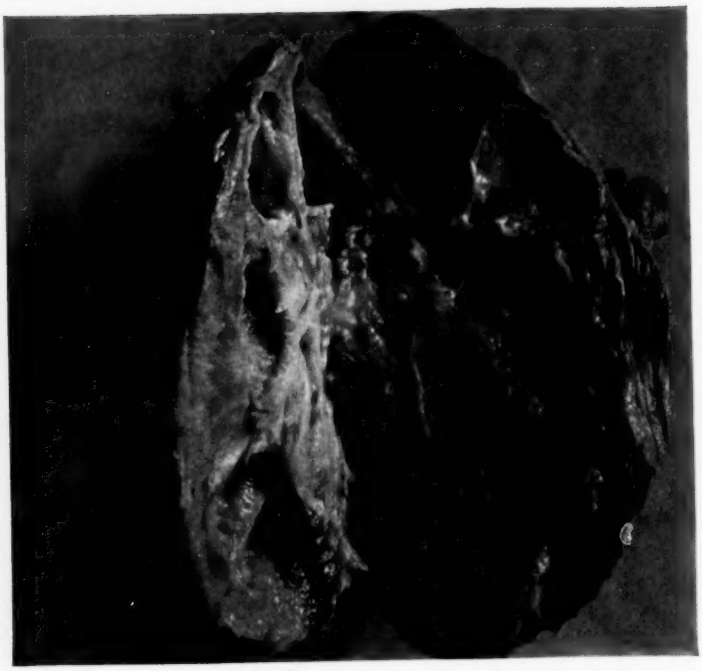
Five weeks after operation, showing location of incision (König).

FIG. 2.



Kidney irregularly distended with pus. The enlarged ureter is seen below.

FIG. 3.



Kidney bisected, showing pus pockets.

*Operation* (November 11, 1910).—(*a*) A vaginal incision one and a half inches long to the right and forward from the cervix exposed the cord-like ureter, which was isolated without difficulty by blunt dissection. Being quite rigid and fragile, it was unfortunately broken off while being hooked down. The short end was teased out until the bladder insertion rose as a cone on traction. It was tied off with catgut and cut away. The upper end was teased out well into the broad ligament and then temporarily left, a suture was placed in each end of the incision, and a wick of gauze inserted. The bleeding was slight.

(*b*) The patient was turned on the left side and an incision made opposite the navel, slightly inclined downward (Koenig). It extended back to the edge of the quadratus. Peritoneum pushed forward and inward, opened and no disease found in other regions, no fluid. Opening immediately sutured with catgut. Kidney enucleated around to the vessels, the cava was exposed, the vessels were freed from fat, and tied with chromicised catgut without bleeding. Pelvis rigid, as was the ureter. With gauze covered finger the pelvis and ureter were enucleated retroperitoneally from a bed or sheath of inflammatory tissue, the iliac vessels were exposed and passed, the dissection continuing through the broad ligament until the lower end was released where it had previously been freed below. No leakage of pus, no large vessels required ligature, no bleeding of importance. Wound closed over small tube drain. Convalescence uneventful. Gauze drain out of vagina in a week. Aseptic healing of abdominal wound, no sinus.

One month later weight had increased eight pounds, general improvement, the cystoscope showing the patch around the right ureter paler and flattened.[1]

After operation the urine from the remaining kidney showed no tubercle bacilli, no pus, and no casts.

On section the pelvis and calices of the kidney were found filled with creamy fluid which yielded a pure culture of the *Bacillus alkaligenes*. In the laboratory of the hospital serial cross sections of the ureter were made at various levels. These sections as well as those from the kidney showed many tubercles and giant cells, with inflammatory infiltration. Diagnosis: tuberculosis of kidney and ureter.

[1] April 1, 1911, gain of 32 pounds within five months.

The operation of simultaneous removal of the kidney and ureter was first done by H. A. Kelly in December, 1895, Dr. A. J. McCosh operating a month later. In 1903 Dr. J. W. Bovee collected seventeen cases, and later [2] reported four others of his own. Operators have recommended various routes, transperitoneal or retroperitoneal; some working entirely from above, some reaching the lower part by a second incision near the semilunar line or in the vagina. Following Bovee I found the Koenig or transverse incision back from the semilunar line to give much easier retroperitoneal access than one in the loin, particularly as in this case the organ was prolapsed and well forward. Experience in many combined vaginal and abdominal operations for other conditions has convinced me that vaginal work should be done first, as the strain begins when the peritoneum is invaded above, and the patient should be returned to bed as soon afterward as possible.

Collated experience is proving that the ureter does not usually require removal in nephrectomy for tuberculosis. When, however, it is greatly enlarged and hardened all the way down, it is likely to give rise to a troublesome sinus if not removed. The ureteral catheter is not necessary even if it could be passed, as when the firm, hard cord can be felt in the vagina, no other guide is needed, and if this cannot be felt, the ureter may be left in, at least low down. After removal of the kidney which has been pouring infectious material through the bladder, the tendency of that organ to recovery is so great that it appears not necessary to remove bladder wall around the ureteral opening, unless the cystoscope shows deep invasion sharply localized.

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[2] Jour. Amer. Med. Association, Oct. 23, 1909.

# RESULTS OF THE USE OF THE MOORHOF BONE PLUG IN THE SURGICAL CLINIC OF THE UNIVERSITY OF MINNESOTA.

BY J. CLARK STEWART, M.D.,

OF MINNEAPOLIS, MINN.,

Assistant Chief of Surgical Clinic.

THE use of the Moorhof bone wax has revolutionized bone surgery in our clinic. We employ it in many ways not advised by its originator, and with such regular success that it seems difficult to see why others have troubles in its use.

In a late number of the ANNALS OF SURGERY Dr. Simmons gives an interesting account of the use of the wax in a restricted class of cases. His experience and conclusions differ so radically from ours that it seems wise to make a short report of our methods and results.

First, as to its field, we use it whenever we wish to fill any bone defect; in cavities made in healthy bone; in defects left by the removal of fragments in some compound fractures; in acute osteomyelitis both as a temporary filling to avoid gauze packing and as a permanent stopper of the evacuated cavity; in all forms of subacute and chronic osteomyelitis including bone abscess; in tuberculosis of both bones and joints.

Second, we regularly get union by first intention in most cases of chronic and subacute osteomyelitis and tubercular cases. In the more recent infective osteomyelitis, temporary drainage generally suffices to ensure the retention of the wax and closure of the wound over same.

Third, we have had no cases of extrusion of the wax or reopening of the wound and escape of serum and wax. On the contrary, wounds which have opened early from cutting out of stitches or tension, exposing the wax, have regularly granulated over the wax, leaving it *in situ* as shown by later skiagraphs. In a few very acute cases with infection of the

soft parts, the wax has been used as a temporary dressing, being replaced once or twice before the wound is closed over it. Our technic differs in these various cases.

In acute cases operated upon under Esmarch's ischæmia, the cavity resulting from the operations on the bone is merely mopped out with carbolic acid, followed after one minute by alcohol, then dried and filled with the Moorhof wax, and the soft parts sutured and drained before removing the Esmarch.

In less acute cases the same technic is used, except that the Esmarch bandage is removed and all bleeding checked before drying and filling the bone cavity. This is done by alcohol, pressure, and hot air, and the periosteum and soft parts are then closed without drainage.

While we have had a certain number of failures to unite by first intention, we have observed no cases of extrusion of the wax. The period of absorption of the wax varies; we have observed it as late as one year after operation, and in one case of normal cancellous bone noted below, there was very little absorption during this period.

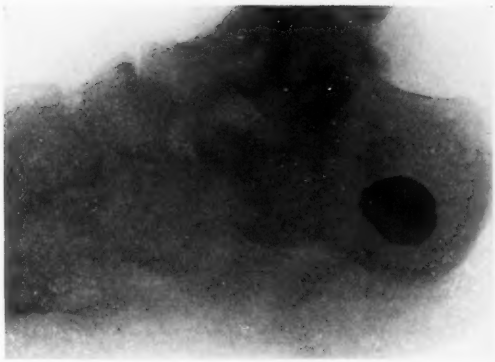
We have had no case of iodoform poisoning, although as high as one pound of the 40 per cent. wax has been used in a femoral cavity; but the urine has reacted for iodine in a few cases.

Case I.—This skiagram shows a mass of wax in a cavity made in error in a healthy os calcis, over a year after its introduction. Scarcely any absorption. No opening of wound or extrusion. Case under observation since 1904.

Case II.—No skiagram. Private case of Dr. J. E. Moore. Compound fracture of neck of femur by gunshot wound. Destruction of large part of great trochanter. Fragments removed and gap in femoral neck filled with bone wax. Superficial parts sloughed and suppurated; wax remained. Good union with slight shortening and good function.

Case III.—Skiagrams of tibia. Boy four years old. Acute osteomyelitis of two months' standing, with discharging sinus near ankle. Operation showed destruction of lower end of tibia,

FIG. 1.



Cavity in os calcis filled with bone wax; condition one year after introduction of wax. (Case I)

FIG. 2.

Lateral view through plaster cast of abscess cavity in tibia filled with bone wax. (Case III.)

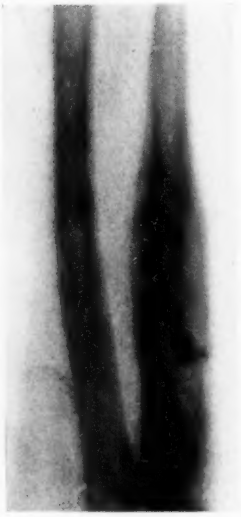
FIG. 3.

Anteroposterior view through plaster cast. (Case III.)

FIG. 4.

Abscess of humerus filled with bone wax. (Case IV.)

FIG. 5.

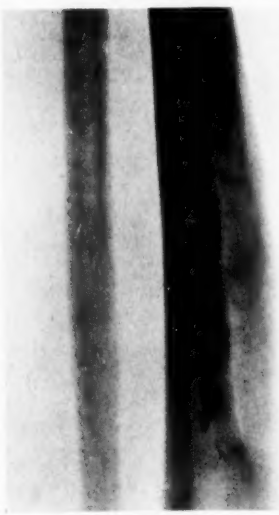


Abscess of ulna which had been filled with bone wax; wax nearly absorbed. (Case IV.)

FIG 6.

Anteroposterior view of cavity in tibia filled with bone wax. (Case V.)

FIG. 7.



Lateral view. (Case V.)

including all but a shell of the epiphysis, but with intact articular cartilage. Cavity scraped, cleansed, and filled with bone wax with temporary drain. Drain removed in one week; wound closed in two weeks. Skiagram three weeks after operation. Wound has remained closed since 1906. Good function of ankle-joint, and no deformity.

CASE IV.—Skiagrams of humerus and opposite ulna taken six weeks after operation. Multiple suppurative osteomyelitis in boy ten years old. Cavities cleansed and filled with wax with temporary drainage. No relapse or further discharge after four weeks.

CASE V.—Skiagrams of tibia taken eight and a half months after operation. Chronic non-suppurative osteomyelitis. Woman aged twenty-seven. Cavity six inches long filled with wax. No drainage. Skin tension caused opening of wound, which granulated over wax without loss of latter, as shown by skiagram. Skin now movable over bone, and the latter smooth without depression.

# A FURTHER NOTE ON THE CLINICAL USE OF SCARLET RED AND ITS COMPONENT, AMIDOAZOTOLUOL, IN STIMULATING THE EPITHELIATION OF GRANULATING SURFACES.*

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*Introduction.*—In a paper published in the *Johns Hopkins Bulletin,* in June, 1909, and in the ANNALS OF SURGERY of January, 1910, I reported the results of my observations during the treatment of 60 cases with scarlet red in various combinations.

Since that time I have been impressed by the great interest in the clinical use of this dyestuff by the large number of papers on this subject which have appeared in the foreign journals, and also by a number of personal communications reporting favorable results.

The object of this article is to bring this subject up to date as far as possible, and in addition to make a few observations on the clinical use of amidoazotoluol, which was first tried by Hayward [22] and is a component of the scarlet red originally used by Fischer.[14]

I was very skeptical when I began to experiment with scarlet red. It was difficult to believe that by the application of a commercial dyestuff such rapid epithelial stimulation could take place in sluggish wounds, some of which had been unhealed for many years.

It has been suggested that possibly the wounds healed with scarlet red were in a period of development in which, after being inactive for a longer or shorter time, the rapid epithelial growth would have taken place just as well under any other method of dressing. This may be true in a few instances, but I hardly believe it could have been the case in the large number of cases reported, where the process of healing had been at a stand-still until this dressing was begun.

* Read before the Johns Hopkins Medical Society, April 3, 1911.

Carrel, in his very interesting article on "The Treatment of Wounds" (*Jour. Amer. Med. Assoc.*, December 17, 1910, p. 2148), says that when at the end of the period of "granulous retraction" of a large wound the edges of the old epidermis are still at a distance of 20–25 mm., the new epidermis cannot spread on the granulations and the cicatrization of the wound comes to a stand-still.

Now, in practically all of the wounds which I have treated with scarlet red and amidoazotoluol, the period of "granulous retraction" had long since ceased, the period of epidermization had also come to a stand-still, and the areas were, for the most part, very large. In spite of these facts, in the large majority of cases there was marked epithelial stimulation from the hitherto sluggish edges following the application of the dyestuff, and subsequent rapid healing.

Scarlet red was used exclusively as a dye until 1900, when Michealis [34] found that this coloring matter was very suitable for staining fat in the cellular tissue for microscopic examination.

*Experimental Use.*—B. Fischer,[14] in 1906, in a paper on the "Experimental Generation of Atypical Epithelial Proliferation," produced by the subcutaneous injection of a saturated solution of scarlet red, in olive oil, in a rabbit's ear, first called attention to the remarkable stimulating properties of this dyestuff, and suggested that therapeutic advantage might be taken of it. Since his publication a number of investigators (Ritter,[42] Jores,[27] Geipel,[15] Snow,[49] Stahr,[52] Wyss,[59] Helmholz,[23] McConnell,[32] Seckel,[47] Hertzler,[24] Schreiber and Wengler,[45] Werner,[56] Enroth,[13] Stoeber,[54] Grimani,[17] Dixon,[9] Cords,[7] Meyer,[33] Borst,[3] Wessley,[57] following Fischer's lead, have repeated his experiments and extended them. As far as I can ascertain all, with the exception of Snow, have agreed that a new growth of epithelium is produced.

Several kinds of animals have been used, rabbits, Belgian hares, guinea pigs, white rats, mice, monkeys, dogs, cats, etc. These proliferations have also been produced in man. Wessley [57] experimented on himself and Stoeber [54] upon a man

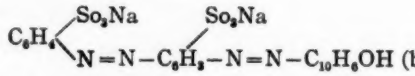
80 years old, whose leg was to be amputated for ununited fracture. The results were not as marked as in the rabbit's ear, on account of anatomical conditions, but were definitely positive. Stoeber injected scarlet red, amidoazotoluol and α-naphthylamin, but did not succeed in producing epithelial proliferation by α-naphthylamin. It is beyond the scope of this paper to discuss the theories as to the cause and source of these atypical epithelial proliferations.

An interesting point is made by Claribel Cone,[6] who says that in the epidermis of man the fat which is shown by the scarlet red stain is especially noted in the basal (germinal) layer at the point of contact of the cell body and nucleus; in other words that the scarlet red attacks the living cell just at the point where physiological cell changes are most active. She suggests that this may cause a chemical or physical stimulation to the cell, and thus account for the active proliferation following its clinical use.

*Chemistry.*—In looking over the literature on the clinical and experimental use of scarlet red, I find that there are several chemically different dyestuffs which are marketed under the name scarlet red. I will consider the chemical formulæ of four of these.

1. The dye used in my series was the sodium salt of diazoazobenzenedisulphonic acid β-naphthol.

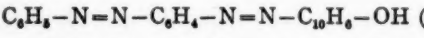
*Commercial Names.*—Biebrich Scarlet; Pouceau 3 RB; Pouceau B; Fast Pouceau B; New Red L; Imperial Scarlet. (Schultz and Julius[6a] (Green), 1904, p. 110, No. 163.)



*Method of Preparation.*—Amidoazobenzenedisulphonic acid and β-naphthol. It is a red powder, soluble in water and slightly soluble in alcohol. Insoluble in ether.

2. Benzeneazobenzeneazo β-naphthol.

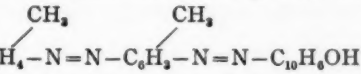
*Commercial Names.*—Soudan III; Cerasine Red. (Schultz and Julius, p. 106, No. 143.)



*Method of Preparation.*—Amidoazobenzene and β-naphthol. It is a brown powder, soluble in alcohol and fats. Insoluble in water.

3. Toluneazotolueneazo β-naphthol. This is the scarlet red originally used by Fischer[14] and Schmieden.[44]

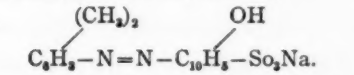
*Commercial Names.*—Oil Scarlet; Red B Oil Soluble Extra-concentrated; Pouceau 3 B. (Schultz and Julius, p. 108, No. 150.)



*Method of Preparation.*—Amidoazoorthotoluene and β-naphthol. It is a dark reddish-brown powder which cakes at about 175° C. and melts at 184° to 186°. Insoluble in water, soluble in alcohol and chloroform, fats, fatty oils, and also warmed vaseline and paraffine.

4. Sodium salt of xyleneazo β-naphthol monosulphonic acid.

*Commercial Names.*—Scarlet GR; Scarlet R; Brilliant Orange R; Orange L. (Schultz and Julius, p. 86, No. 54.)

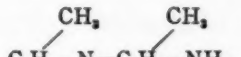


*Method of Preparation.*—Xylidene and β-naphthol monosulphonic acid. It is a cinnibar red powder, soluble in water.

I have used clinically the first three of these preparations with success, and also a xylidene scarlet (Schultz and Julius, p. 86, No. 55), which is closely related to the fourth preparation. I find the best and most consistent results with scarlet red have followed the use of the dyestuff originally employed by Fischer[14] and Schmieden.[44] Hayward[22] says that in the few cases reported where no result was attained, this special dye was probably not used. Hayward has also experimented with Soudan I, Soudan IV and Soudan G, with more or less success.

He says that Fischer and Schmieden thought that α-naphthylamin caused the epithelial stimulation in the most far-reaching way. Hayward used this substance clinically, and found that it caused only marked irritation. This was also my experience when I used β-naphthol ointment of a strength corresponding to that actually entering into the formation of 8 per cent. scarlet red, *i.e.*, 2.4 per cent.

Experimenting further, Hayward employed amidoazotoluol, the other component of scarlet red, and found that this substance caused a more marked stimulating effect on the growth of epithelium than did the scarlet red.



*Method of Preparation.*—Slowly add a saturated solution of sodium nitrate (1 mol.) to a mixture of orthotoluidine (4 mols.) and concentrated hydrochloric acid (2 mols.) and keep at a temperature of 30° to 40°. It is a reddish-brown granular powder. Melting point about 100°. Nearly insoluble in water but easily soluble in alcohol and ether.

*Clinical Use.*—A few words concerning the papers on the clinical use of these substances may be of interest.

Schmieden [44] was the first to follow Fischer's [14] suggestion that scarlet red be used therapeutically, and in February, 1908, published a paper on his clinical results, which were very favorable. He reported rapid healing on sluggish ulcers of various kinds and in different situations. He used 8 per cent. ointment and alternated the dressing every 24 hours with some bland ointment on account of the irritating properties of the scarlet red. He also used with success adhesive plaster impregnated with 10 per cent. scarlet red for strapping leg ulcers.

He insisted that the granulations must be perfectly clean and flat, and said that it was useless to apply the ointment to an unclean ulcer. He noted that there was little chance of cicatricial contraction under this healing, and showed by microscopic examination that the newly-formed skin was the same as the normal skin.

In May, 1908, Kaehler [28] substantiated Schmieden's work and modified his technic. He found good results could also be obtained when scarlet red was used on unhealthy granulating wounds. He healed a varicose ulcer with scarlet red, and then was able to thoroughly clean up this new skin and operate through it for excision of varicose veins, thus showing the stability and quality of the newly-formed epithelium. He completely healed defects of similar size, one with grafts and one with scarlet red, in exactly the same time.

Krajčа,[30] in September, 1908, described further good results. He was the first to use scarlet red in conjunction with Thiersch grafts, and found that the edges of the grafts were stimulated as well as the wound edges. He mentions a number of interesting cases. Some of the ulcers, although of large size, healed in a very short time under this treatment. He found the cutaneous irritation due to the scarlet red to be the exception rather than the rule.

Enderlen,[12] in September, 1908, published very satisfactory results, as did Cernezzi [5] and Hübner,[26] in February, 1909. Wolfrom and Cords [58] in the same month wrote on the successful treatment of ulcers and wounds of the cornea by 5 per cent. scarlet red salve. Excellent results were obtained in a case of keratitis neuroparalytica. An old corneal fistula was closed by this means. A more rapid regeneration of the tissues was noted and sometimes an excess of tissue formation, but this soon flattened.

Sprecher,[51] in March, 1909, reported good results in the treatment of ulcerated lupus vulgaris, ulcers of prepuce, vulva, labia, and cervix, varicose leg ulcers, syphilitic ulcers, ulcers of the breast, etc. He did not observe any local irritation or toxic effect in his series.

Rebaudi,[40] in April, 1909, described the use of scarlet red in gynæcological conditions, and obtained excellent results in the treatment of erosions, tears, etc.

Pleth and Pleth,[38] in May, 1909, detailed the successful use of scarlet red on ulcers of various kinds. Hermann,[25] in June, 1909, reported the success of his treatment with scarlet red of tympanic membrane perforations. He said the duration of the perforation seemingly had no effect on the rapidity of the healing. Suppuration did not appear during this treatment.

Ducros,[11] in July, 1909, reported favorable results on granulating wounds, as did Morawetz,[35] in September of the same year. Hayward [22] wrote in the same month concerning the use of an 8 per cent. ointment of amidoazotoluol, which is, as we have mentioned before, a component of the scarlet red used by Fischer.[14] His results on a number of granulating wounds were even more favorable than with the scarlet red, and he felt convinced that this was the stimulating portion of the dyestuff.

It does not seem possible that amidoazotoluol is alone responsible for the epithelial stimulation, as a number of observers, myself included, have noted very favorable results produced by the clinical use of dyestuffs which do not contain amidoazotoluol.

Grossmann,[18] in December, 1909, reported favorable results with scarlet red salve, amidoazotoluol ointment, and amidoazotoluol gauze, in the treatment of wounds following operations on the nasal passages, and in perforated tympanic membranes. Halle [20] and also Levy [31] said that they had been successful in similar cases with the scarlet red.

Hartmann [21] and Beyer [2] stated at the same meeting that they had used scarlet red in a small number of cases without any particular success. Sonntag [50] and Brühl [4] said they had failed to get rapid results in similar cases.

Auerbach,[1] in 1909, published a number of successful results in the treatment of ulcers occurring in skin and venereal diseases, varicose ulcers, etc. He was unsuccessful in only one case, a multiple leg ulcer which was complicated by extensive varices. The other leg of this patient had been previously amputated for leg ulcer. He used the treatment with success on wounds which were discharging copious purulent secretions. He had irritation with 8 per cent. scarlet red, so tried 4 per cent., which he found could be used continuously. Dauthuile [8] also reported favorable results.

The papers which have appeared in 1910 are as follows: Rammstedt and Jacobsthal [39] mentioned excellent results in the healing of ulcers due to X-ray burns. Dreifuss [10] reported favorable results in the treatment of granulating wounds. Cords [7] said it was of use in the eye only in clean ulcers of the cornea, especially if there was deep loss of substance.

Pein [37] detailed a number of cases successfully treated with scarlet red, and gave a very interesting table of the measurements, taken from 25 leg ulcers, from the beginning of the treatment to the time of healing.

Strauss [55] published his very favorable results in the treatment of X-ray burns and other ulcers of various kinds. He says he does not value the use of scarlet red for the rapidity of epitheliation alone, which in some cases does away with the necessity of Thiersch grafting, but for the solid epithelium, which is of great value, especially in the region of the joints. By this healing, contractions and scar tensions can be avoided. Stein [53] reported good results in otiatrics. Scharezki [43] was

very sucessful in the treatment of skin defects of various kinds.

Katz [29] reported favorable results with 8 per cent. scarlet red and amidoazotoluol. Simin [48] had excellent results following the use of scarlet red.

Nance (*Jour. of Ophthalmology and Oto-Laryngology*, Feb., 1911, p. 41), reported very favorable results with scarlet red in the treatment of corneal defects.

It can be seen from the above that by the use of scarlet red and amidoazotoluol very satisfactory results have been obtained. The tone of nearly all of these papers has been enthusiastic, and the only unfavorable results are those reported by Hartmann [21] and Beyer,[2] Sonntag [50] and Brühl.[4] All of these were in aural cases.

Since the publication of my paper, I have continued to use scarlet red on a number of other cases with almost uniform success, and have little to add to the technic described at that time.

I find marked epithelial stimulation even when the wounds are unhealthy and the discharge is profuse. This has also been the experience of Kaehler [28] and Auerbach,[1] although nearly all the other writers, beginning with Schmieden, have stated that it is useless to apply the scarlet red ointment to any but a perfectly clean granulating wound. Of course the most rapid results are obtained on flat, healthy, granulating surfaces, but a great deal of progress can be made by its use while the granulations are being brought into this condition.

Strauss [55] objects to the use of scarlet red put up in balsam of Peru ointment, blue ointment, iodoform ointment, etc., as recommended by me, in the treatment of unhealthy granulating wounds, on the ground that the ointment is of no use on such ulcers, but my experience has evidently been very different from his. I consider the use of such combinations to be of value in the treatment of unhealthy granulating wounds, as the scarlet red in itself has no antiseptic qualities, and the cleansing process due to the balsam of Peru, etc., can in this way be carried on while the scarlet red is being used, as well as by the alternating dressing.

*Technic.*—An outline of the technic will suffice. Cleanse

the wound thoroughly with boric or salt solution and dry. Peroxide of hydrogen may be used before the boric solution if the granulations are unhealthy. The free use of nitrate of silver stick is advised to keep down exuberant granulations. Tincture of iodine, U.S.P. strength, may follow the silver nitrate or be used on alternating days, and is a powerful and rapid method of cleansing granulations.

The strength of the scarlet red ointment ordinarily used is 8 per cent., and it should be alternated every 24 to 48 hours with some bland ointment. By applying a weaker ointment, say 4 per cent., it can be used over longer periods without danger of the severe irritation which occasionally occurs.

The most satisfactory method of applying the ointment is as follows: Anoint the skin surrounding the defect with some bland ointment up to about one centimetre of the wound edge, as this prevents possible irritation. Then spread the scarlet red ointment in a thin layer on perforated old linen and apply to the wound, either along the edges or over the whole surface. A light dressing of sterile gauze secured by a bandage completes the procedure.

I have applied the scarlet red ointment to a number of wounds and then exposed them to the air and sunlight. The healing is very rapid and the drying out of the surface is most noticeable.

It is safe to use a 4 per cent. scarlet red ointment on partial skin grafts of all kinds 48 hours after grafting, and there is rapid stimulation of the wound edges and also of the grafts themselves.

*Case Reports.*—I will mention only one case to illustrate the efficacy of scarlet red:

A very feeble old lady, eighty-four years old, was badly burned across the shoulders six weeks before she came under my care. During that time she had been carefully treated by her family physician with the usual methods. The wounds had done well for several weeks, and then had become sluggish and no further progress could be made. The patient's general condition was bad on account of a weak heart and chronic nephritis, and was becoming serious under the strain. I was called to consider the advisability of grafting.

There were three ulcers, one over the right scapula, 5 x 10 cm., another over the left scapula, 5 x 8 cm., and a third ulcer 8 x 10 cm. situated in the midline between the other two. Those over the scapulæ were covered with clean but œdematous granulations, which had not yet reached the level of the skin. The central wound was still covered, to a large extent, by a slough which was made up of the whole thickness of the skin and some subcutaneous tissue. The epithelial edges of these ulcers were very sluggish.

On account of the condition of the patient and the situation of the wounds, I decided to try scarlet red instead of grafting.

November 26–27, 1910: The wounds were dressed with a balsam of Peru and castor oil mixture, 2 to 6.

November 28: Scarlet red, 8 per cent., was applied, and thereafter every third day, alternating with boric ointment.

December 7: The last of the slough was removed. December 16: The wound over the left scapula was healed. December 23: The central wound was healed. December 25: The wound over the right scapula was healed.

During the treatment the patient was in a critical condition almost continuously, and had to be strongly stimulated in order to preserve life.

The case is instructive from the fact that old age and great debility seem to have little deterrent effect on the stimulating power of scarlet red. The skin edges were stimulated in spite of the presence of a slough in the central wound. It was only necessary to use the scarlet red ointment in nine dressings to complete the healing. The result was a firm, thick, and stable skin, which showed no tendency to contract.

After the appearance of Hayward's [22] paper on the efficacy of amidoazotoluol, I had the opportunity of using this substance on a number of granulating wounds of varying etiology. The results have been excellent.

Calculating the amount of amidoazotoluol in scarlet red from the molecular weights, we find that there is 3.76 per cent. of amidoazotoluol in an 8 per cent. scarlet red ointment. I have used this strength as well as 8 per cent. in simple vaseline, and also in the balsam of Peru and other ointments suggested earlier in the paper. I will illustrate the efficacy of amidoazotoluol by briefly reporting two cases.

CASE I.—A boy, fourteen years old, fell into the fire while in an epileptic attack and was severely burned. He was admitted to the hospital and was much improved, during his five months' stay, by grafting and various other methods. He was then sent to the Out-Patient Department for dressing, and as no further progress was made in the healing, he was referred to me eight months after the accident.

The size of the unhealed areas at this time can be well made out in the illustrations. The wounds were covered with very exuberant granulations which secreted actively. The epithelial edges were at a stand-still. The patient refused to be grafted, and it was decided to try 8 per cent. amidoazotoluol ointment. The granulations were trimmed off with scissors, then cauterized with silver nitrate, and this was followed by tincture of iodine. This procedure was carried out whenever necessary throughout the treatment.

February 24, 1910 (Fig. 1): All of the ulcers were dressed with amidoazotoluol ointment and this was alternated every 24 to 48 hours with balsam of Peru and oil, zinc oxide, or boric ointment. A stimulation of the epithelial edges was noticeable within 48 hours.

After the first dressing of the large areas with amidoazotoluol, a temporary change of color was noticed in the urine. The patient was dressed at 5 P.M. and the urine voided was as follows: February 24, 6.40 P.M., watery, 500 c.c.; 9.30 P.M., light lemon, 450 c.c.; February 25, 4.30 A.M., *amber*, 430 c.c.; 7.50 A.M., *reddish brown*, 240 c.c.; 11 A.M., *reddish brown, slightly darker*, 80 c.c.; 2.30 P.M., watery, 280 c.c.; 5.55 P.M., watery, 200 c.c.; 7 P.M., watery, 360 c.c. Otherwise the urine was negative. The subsequent dressings did not cause a change in the color of the urine.

May 9: The patient was discharged entirely healed. The healing was firm, thick, and looked like normal skin. Examination of this patient six months later showed a firm, movable skin, with normal sensation and no tendency to contraction.

CASE II.—A man, thirty years old, was severely burned by an explosion of oil. He came under my care on May 5, six months after the accident, and one of the unhealed areas is well shown in the figure. This wound had improved for a time and then had become sluggish, and apparently no further progress could be made from the epithelial edges. Several unsuccessful graftings had been previously done.

The wound was covered with œdematous exuberant granula-

FIG. 1.

*a*.

*b*.

*c*

Case I. Sluggish ulcers following burn. Healed with amidoazotoluol. *a*, *b*, taken February 24, 1910, eight months after the accident. The ulcers are surrounded by scar tissue. There is partial web formation in the axilla. The exuberant granulations and sluggish wound edges can be well seen. *c*, taken May 9, 1910. Shows the character of the healing. There is no tendency to contraction. The web formation is less marked.

FIG. 2.

*a.*

*b.*

Case II. Sluggish ulcer following burn. Healed with small deep grafts and amidoazotoluol. *a*, taken May 30, 1910, six months after the accident. The ulcer is surrounded by scar tissue. The small deep grafts applied May 28 have all taken and the wound edges have begun to spread. *b*, taken June 4, 1910. Shows the very rapid epithelial stimulation from the grafts and wound edges after two dressings with amidoazotoluol. The entire wound is healed with the exception of a few small areas, whose aggregate size is not larger than a ten cent piece.

FIG. 3.

*a.*

*b.*

Case II. *a*, taken June 24, 1910. Shows the remarkable thickening of the grafts, which project like little warts above the skin level. *b*, taken August 9, 1910. The grafts have assumed the level of the surrounding skin. Considerable pigmentation can be seen in the healed area surrounding the grafts.

tions which were exquisitely tender. An effort was made to put the granulations in a healthy condition as soon as possible. Toward the end of this process 4 per cent. amidoazotoluol ointment was used as a dressing, and was followed by marked stimulation of the edges.

On account of the tenderness it was decided to graft. The patient refused to allow Thiersch or whole thickness grafts to be cut.

May 28: The granulations being in good condition, a number of small deep grafts were taken from the thigh under local anæsthesia and transplanted on the undisturbed granulations. The grafts were dressed with narrow overlapping strips of protective, over which was placed a dry dressing.

May 30: The dressing was changed, and all the grafts were found to have taken (Fig. 2, *a*).

June 1: The grafts were dressed with 4 per cent. amidoazotoluol on old linen. When the dressing was removed 48 hours later it was noted that the grafts were markedly stimulated. Dressed with boric ointment.

June 4: The entire wound, with the exception of one or two small areas, was covered with epithelium (Fig. 2, *b*).

June 11: The wound was entirely healed with firm resistant epithelium, which required no further dressing. Four applications of amidoazotoluol had been made. The grafts themselves had become much thickened and projected above the surrounding skin like little warts (Fig. 3, *a*). This condition disappeared, and the entire area assumed the normal level (Fig. 3, *b*).

Examination of this patient eight months later showed a firm, movable skin with normal sensation. There was still some pigmentation around the grafts, but this was less marked than at date of discharge.

*Comments.*—I was able to compare the rapidity of healing caused by scarlet red and amidoazotoluol. Following an extensive burn, there were two granulating wounds of about the same size. One was dressed with 8 per cent. scarlet red ointment and the other with 8 per cent. amidoazotoluol ointment. The healing in both was rapid, but the wound dressed with amidoazotoluol healed first. The character of the healing was practically the same.

The age of the patient seems to have little effect on the stimulating power of these ointments. The general health of

the patient is most important, and in some instances forced feeding, fresh air, and tonics must be resorted to.

It is interesting that a number of patients with exquisitely painful ulcers have remarked that there is less discomfort after dressing with these substances than after any other dressing, however bland.

In none of the cases have I noted the slightest irritation of the surrounding skin following the use of amidoazotoluol. Although this dressing can be used continuously without irritation, it is best to apply it for 48 hours and then alternate with some bland ointment for 24 hours.

Dressing with both substances causes excess of secretion for one or two applications, but there is marked drying out of the granulations in a short time.

The use of scarlet red and amidoazotoluol in blue ointment is advantageous in the treatment of syphilitic ulcers, and in addition constitutional treatment should always be employed.

In the treatment of second degree burns the ointment can be used immediately after the blisters have been cut away. In third degree burns it is best to wait until the granulations have started.

For a time after healing, the newly formed skin has a tendency to be dry and somewhat scaly, but this is easily overcome by the application of olive oil or vaseline.

I have not yet seen a wound break down which was healed by the use of scarlet red or amidoazotoluol, although some of the cases have been under observation for over two years.

A grayish membrane is often seen on the granulations after the application of scarlet red ointment. I have not observed this formation following the use of amidoazotoluol.

Thiersch and Reverdin grafts are sometimes tremendously thickened following early dressings with these substances, but this thickening disappears within a few weeks.

At times it is advantageous to apply either ointment directly to the wound and then expose to the sunlight and air.

Scarlet red and amidoazotoluol gauze is prepared by saturating gauze with a 4 per cent. or 8 per cent. alcoholic solution of the substances and then allowing it to dry.

The substances can be used as a dusting powder by the

addition of 4 per cent. to 8 per cent. strength to boric powder. I have also tried the full strength powder on a few wounds without irritation. The effect of the scarlet red and amidoazotoluol used in this way is very rapid drying out of the wound and the formation of a tough scab under which the healing takes place.

A simple and satisfactory method of preparing scarlet red and amidoazotoluol ointment is to rub up the substance with a small amount of almond oil until the mass is smooth, and then mix this mass thoroughly with the base.

Both these ointments can be sterilized without interfering with their stimulating properties.

As a rule there is no toxic effect either from scarlet red or amidoazotoluol. Gurbski [19] reports the only case in which any general toxic effect was noted, as follows:

> A child, eleven years old, was severely burned by an explosion of turpentine. The lower two-thirds of the thigh and the entire leg to the ankle were involved. After the granulations had formed Gurbski applied 8 per cent. amidoazotoluol ointment. Fifteen hours after the application the patient, who had previously been in very good health, began to complain of headache and dizziness. This was followed by violent vomiting and gastralgia. The pulse rose to 110 and was of low tension. The temperature rose to 102.38. There were cyanosis of the lips and albumin in the urine.
>
> The dressing was removed and the patient placed on a milk diet. In a few hours all of these phenomena disappeared. Eight days later amidoazotoluol ointment was again applied and the same symptoms reappeared with the exception of the albuminuria. A third dressing five days later caused the same symptoms except that the vomiting was less marked.
>
> During the rest of the treatment he applied the ointment to only one-fourth of the wound at a time, and the toxic symptoms did not again occur. Rapid healing followed.

Gurbski [19] thinks the poisoning was due to the amido group in the amidoazotoluol.

I have dressed very large granulating areas for some time with these substances without any deleterious effect.

In this connection an observation by Stoeber is of interest. He says that it is not uncommon to have bladder disturbances among the men who work in the manufacturing of dyes. This trouble is principally among the workmen occupied in the

manufacture of amido combinations of benzol and naphthalin, or in factories where these products are used. The disease is characterized by cyanosis, vertigo and weakness, strangury, and bloody urine. In addition to the above symptoms, in long continued handling of these dyestuffs, hemorrhages and tumor formations in the bladder are observed. None of these symptoms have been noted following the clinical use of scarlet red or amidoazotoluol, except as noted above.

The consensus of opinion is that there is no danger of producing malignant growths by the clinical use of these substances. My own experience has convinced me of this, and although occasionally there is an overgrowth of epithelium, this soon assumes the level and the appearance of the normal skin.

Some authors have gone so far as to state that by the use of scarlet red and amidoazotoluol the majority of skin grafting can be eliminated. This is too broad a statement, but there is no doubt that wounds can be healed by these compounds which could not otherwise be satisfactorily closed except by grafting.

Scarlet red and amidoazotoluol will not heal every wound, but in the majority of cases, when applied with the proper technic, they will cause epithelial stimulation in the edges of the most sluggish wounds, and give a rapid healing which is stable and resistant, and which has the macroscopic and microscopic appearance of the normal skin. There is no tendency to subsequent contraction, and the skin becomes movable on the underlying tissues in a reasonable time. Any one of these characteristics would make the use of these substances well worth trying.

## BIBLIOGRAPHY.

[1] Auerbach: Ueber den Therapeutischen wert der Scharlachsalbe bei Haut und Geschlechtskrankheiten, Klin. therapeutische Wochenschr., Nr. 14, 1909, p. 594.

[2] Beyer: Discussion of Grossmann's paper, Deutsche. med. Wochenschr., Nr. 13, April 21, 1910, p. 777.

[3] Borst: Atypische Epithelwucherungen, Deutsche. med. Wochenschr., Nr. 34, August 25, 1910, p. 1586.

[4] Brühl: Discussion of Grossmann's paper, Deutsche. med. Wochenschr., Nr. 13, April 21, 1910, p. 777.

[6] Cernezzi: Dell'influenza Eccitatrice avolta dallo Scarlatto R (Michaelis), sulla Rigenerazione dell'Epitelio Cutaneo, Gazzetta degli Ospedali e delle Cliniche, No. 14, February 2, 1909, p. 145.

[7] Cone: Zur Kenntnis der Zellveränderungen in der normalen und pathologischen Epidermis des Menschen. Franzfurter Zeitschrift f. Pathologie, vol. i, 1907, p. 37.

[8] Cords: Experimentelle und klinische Erfahrungen über die Wirkungsweise des Scharlachrot bei Hornhauterkrankungen, Klin. Monatsbl. f. Augenheilkunde, January, 1910, p. 1.

[9] Dauthuile: Epidermisation rapide d'une vaste escarre gangreneuse de la face antero-externe de la cuisse gauche par des applications de Scharlachrot: Action remarquable de cette substance colorante sur les plaies atones, Nord. med. Lille, 1909, xvi, p. 169.

[10] Dixon: Proliferations of the Epithelium Induced by Soudan III, Scharlach Roth, and Paraffin; and the Effects of Röntgen Irradiation on the Same, Jour. Infectious Diseases, vol. vi, No. 2, April 1, 1908, p. 205.

[11] Dreifuss: Behandlung granulierender Wundflächen 8 per cent. Scharlachrotsalbe, Deutsche. med. Wochenschr., Nr. 1, January 6, 1910, p. 52.

[12] Ducros: Ueber die behandlung granulierender Wunden mit Scharlachrot., Deutsche. med. Wochenschr., Nr. 29, July 22, 1909, p. 1294.

[13] Enderlen: Empfehlung der Scharlachrotsalbe sur Beschleunigung der epitheliserung granulierender Flächen., Würzburger Aerzteabend., February 20, 1908; Münch. med. Wochenschr., Nr. 39, September 29, 1908, p. 2066.

[14] Enroth: Epithelization of Granular Tumors by Scarlet Red, Finska lak.-sallsk. handl. Helisingfors, 1909, ii, v. 2, p. 217.

[15] Fischer: Die experimentelle erzeugung atypischer Epithelwucherungen und die entstehung. bosartiger Geschwülste, Münch. med. Wochenschr., Nr. 42, October 16, 1906, p. 2041.

[16] Geipel: Artefiziell erzeugten Geschwülsten, Münch. med. Wochenschr., Nr. 21, May 21, 1907, p. 1057.

[17] Gottheil: Scarlet Red, Pro. Med., vol. xii, No. 3, September, 1910, p. 131.

[18] Grimani: Studio Sperimentale sulle Proliferazioni dell'epitelio Cutaneo., Rivista Veneta di Scienze Mediche, T. 50, April 15, 1909, p. 289.

[19] Grossmann: Erfahrungen uber die Anwendung der Scharlach-R-Salbe (Schmieden), der Scharlachsalbe (Hayward), und der Amidoazotoluolgaze (Epidermolgaze), in der Ohrenheilkunde, Deutsche. med. Wochenschr., Nr. 16, April 21, 1910, p. 777.

[20] Gurbski: Beitrag. zur giftigen Wirkung der Scharlachsalbe, Zentralbl. f. Chir., Nr. 49, December 3, 1910, p. 1550.

[21] Halle: Discussion of Grossmann's paper, Deutsche. med. Wochenschr., Nr. 13, April 21, 1910, p. 777.

[22] Hartmann: *Ibid.*

[23] Hayward: Weitere klinische Erfahrungen über die Anwendung der Scharlachfarbstoffe und Komponenten zur beschleunigten epithelialisierung granulierender Flächen., Münch. med. Wochenschr., Nr. 36, September 7, 1909, p. 1836.

[23] Helmholz: Experimental Epithelial Proliferations of Skin and Mucous Membranes, Johns Hopkins Hospital Bulletin, September, 1907, p. 365.
[24] Hertzler: The Etiology of Epithelioma; a Laboratory and Clinical Study, Jour. Amer. Med. Assoc., February 8, 1908, p. 425. The Etiology of Epithelioma, Jour. Amer. Med. Assoc., Dec. 31, 1910, 2290.
[25] Hermann: Scharlachrot bei Trommelfellperforationen, Deutsche. med. Wochenschr., Nr. 22, June 3, 1909, p. 977.
[26] Hübner: Aerztlicher Verein zu Marburg, December 16, 1908; Münch. med. Wochenschr., Nr. 8, February 23, 1909, p. 424.
[27] Jores: Ueber art und Zustandekommen der von B. Fischer Mittels scharlachöl erzeugten Epithelwucherungen, Münch. med. Wochenschr., Nr. 18, April 30, 1907, p. 879.
[28] Kaehler: Epithelisierung von Wundflächen unter Scharlachsalbe (Nack Fischer-Schmieden), Med. Klin., Nr. 22, May 31, 1908, p. 836.
[29] Katz: Ueber die behandlung granulierender Wunden mit Amidoazotoluolsalbe, Deutsche. med. Wochenschr., Nr. 36, September 8, 1910, p. 1665.
[30] Krajca: Zur epithelisierung granulierender Flächen durch Scharlachrotsalbe, Münch. med. Wochenschr., Nr. 38, September 22, 1908, p. 1962.
[31] Levy: Discussion of Grossmann's paper, Deutsche. med. Wochenschr., Nr. 13, April 21, 1910, p. 777.
[32] McConnell: The Experimental Production of Epithelial Proliferation, Jour. Amer. Med. Assoc., November 2, 1907, p. 1498.
[33] Meyer: Experimentelle Epithelwucherungen. Ziegler's Beitrage z. pathologischen Anatomie und Allgemeinen Pathologie, B. 46, H. 3, 1909; Münch. med. Wochenschr., Nr. 8, March 8, 1910, p. 538.
[34] Michealis: Quoted by Reinhardt, Biebricher Scharlach R., Apotheker-Zeitung, Nr. 10, February 3, 1909, p. 90.
[35] Morawetz: Erfahrungen über die behandlung granulierender Wundflächen mit Scharlachrotsalbe, Therapeutische Monatshefte, Bd. 23, September, 1909, p. 479.
[36] Nietzki: Chemie der Organische Farbstoffe, 1901.
[37] Pein: Ueber die Behandlung des ulcus cruris mit Scharlachrot., Die Therapie der Gegenwart, March, 1910, p. 121.
[38] Pleth and Pleth: The Use of Fluorescent Salts (Eosin, Scarlet Red, etc.) in the Practice of Surgery, Amer. Jour. Surg., May, 1909, p. 162.
[39] Rammstedt und Jacobsthal: Ueber Schädigungen der Haut durch Röntgenstrahlen, Fortschritte auf den Gebiete der Röntgenstrahlen, B. 14, 1909–1910, p. 14.
[40] Rebaudi: Intorno alle utili Applicazioni Therapeutische dello Scharlachrot, La Ginecologia Moderna, April, 1909, p. 217.
[41] Reinhardt: Biebricher Scharlach R., Apotheker-Zeitung, Nr. 10, February 3, 1909, p. 90.
[42] Ritter: Atypische Epithelwucherungen die durch Injection von Scharlachöl am Kaninchenohr Hervogerufen sind, Münch. med. Wochenschr., Nr. 11, March 12, 1907, p. 542.
[43] Scharezki: Zur Frage von der Bedeckung von Hautdefkten (Russki Wartsch, Nr. 21, 1910). Zentralbl. f. Chir., Nr. 32, August 6, 1910, p. 1061.

[46] Schmieden: Epithelwachstum unter Einwirkung von Scharlach R., Zentralbl. f. Chir., Nr. 6, February 8, 1908, p. 153.

[45] Schreiber und Wengler: Ueber Wirkunger des Scharlachöls auf die Netzhaut mitosenbildung der Ganglienzellen, Münch. med. Wochenschr., Nr. 35, September 1, 1908, p. 1854. Also, V. Graefes Arch. f. Ophthalmologie, Leipsic, 74, January, 1910, p. 1.

[46] Schultz and Julius: (Green.) A Systematic Survey of the Organic Coloring Matters, 1904.

[47] Seckel: Ueber experimentell erzeugte atypische Epithelwucherungen, Münch. med. Wochenschr., Nr. 4, January 28, 1908, p. 199.

[48] Simin: Das Scharlachrot als ein Epithelisation ver stärkendes Mittel., Zentralbl. f. Chir., Nr. 52, December 24, 1910, p. 1641.

[49] Snow: An Attempt to Produce an Atypical Epithelial Growth by Injection of Scharlach R. in Olive Oil, Jour. Infectious Diseases, vol. iv, No. 3, June 1, 1907, p. 385.

[50] Sonntag: Discussion of Grossmann's paper, Deutsche. med. Wochenschr., Nr. 13, April 21, 1910, p. 777.

[51] Sprecher: Sul Valore Terapeutico del Scharlachrot, Gazzetta degli Ospedali e delle Cliniche., xxx, No. 28, March 7, 1909, p. 289. Also, Klin. therapeutische. Wochenschr., Nr. 13, March 29, 1909, p. 325.

[52] Stahr: Atypische Epithelwucherungen und Karzinom., Münch. med. Wochenschr., Nr. 24, June 11, 1907, p. 1178.

[53] Stein: Ueber die Verwendbarkeit der Scharlachrotsalbe bei Ohrenerkrankungen, Monatschrift f. Ohrenheilkunde und Laryngo-Rhinologie, xliv, 2 Heff., 1910, p. 214.

[54] Stoeber: Experimentelle Untersuchungen über die erzeugung atypischer Epithelwucherungen, Münch. med. Wochenschr., Nr. 3, January 19, 1909, p. 129. Die erzeugung atypischer Epithelwucherungen durch Injektion von Scharlachrot und Amidoazotoluolöl in das subkutane Gewebe des Menschen., Münch. med. Wochenschr., Nr. 14, April 5, 1910, p. 739.

[55] Strauss: Beitrag zur Kenntnis der Wirkung des Scharlach R. auf das Epithelwachstum., Deutsche. med. Wochenschr., Nr. 19, May 12, 1910, p. 895. Pansements des Plaies avec la solution de la Pommade Rouge R., Archives Gènèrales de Chir., T. vi, August 25, 1910, p. 810.

[56] Werner: Ueber den Einfluss des Scharlachrotes auf Mäusentumoren, Münch. med. Wochenschr., Nr. 44, November 3, 1908, p. 2267.

[57] Wessley: Ueber die Wirkung des Scharlachrotöls auf die menschlische Epidermis (Selbstversuch), Med. Klin., Nr. 14, April 3, 1910, p. 542.

[58] Wolfrum und Cords: Ueber die Anwendung von Scarlachrot bei Augenaffektionen, Münch. med. Wochenschr., Nr. 5, February 2, 1909, p. 242.

[59] Wyss: Zur Wirkungsweise der scharlachöl Injectionen B. Fischer's Bei der erzeugung karzinomänlicher Epithelwucherungen, Münch. med. Wochenschr., Nr. 32, August 6, 1907, p. 1576.

# AN IMPROVED DEVICE FOR TRANSFUSION.

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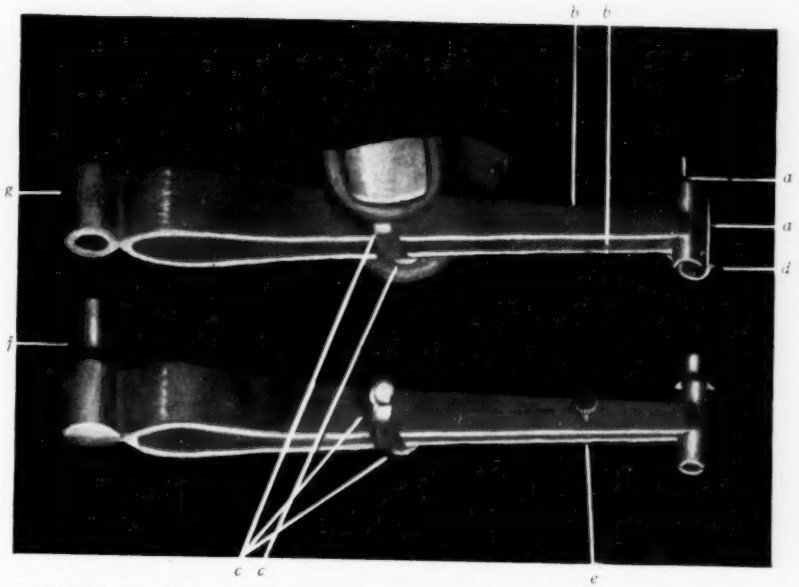
THE accompanying figures illustrate an instrument which facilitates not only the direct transfusion of blood, but also the end-to-end suturing of blood-vessels. It consists of a male and female portion, each of which in turn consists of two small hemicylinders, *a a*. By means of the springy arms *b b*, these hemicylinders unite to form complete cylinders when the instrument is at rest, but are capable of being pressed apart by pressure upon the little knobs, *c c*, to receive between them the blood-vessels to be united.

The method of application is as follows: The artery or vein of the donor is ligated, and by pressure upon the knobs of the male part of the instrument the two halves of its cylinder are separated to permit the vessel of the donor to slip between them upon the proper side of the ligature. By relaxing the pressure the two halves of the cylinder spring together and surround the vessel. The latter is now divided a quarter of an inch in front of the instrument and a cuff from its cut extremity is turned back over the outside of the cylinder surrounding it, where the cuff remains held in place by the little pins, *d d*. The same procedure is repeated with the vein of the recipient.

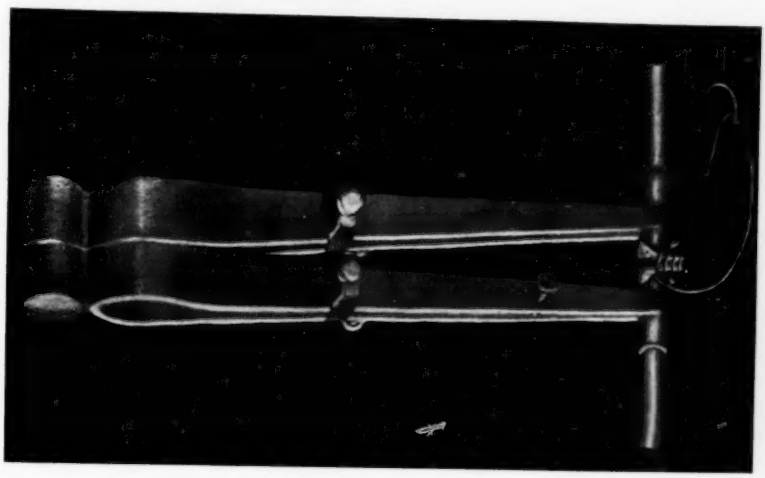
By engaging the shoulder *f* in the socket *g*, the male cylinder, which tapers somewhat so that it is a little smaller than the female cylinder, may be approximated easily within the lumen of the female cylinder and retained in place without support, allowing the blood to flow without leakage though no pressure is exerted to hold the two halves of the instrument together. When the vessels of donor and recipient are of

FIG. 1.




Male (below) and female (above) halves of the instrument. Hemicylinders *a a* separated by pressure on knobs *c c*. Points *d d* for catching turned back cuff of vessel. Screw *e* for gradually separating arms.

FIG. 2.



Suturing turned back cuffs together while blood flows.

very unequal size or in case it is desired to form a permanent union of thicker walled larger vessels the engagement of the male and female halves of the instrument can be facilitated by the use of a second thumb screw for separating the arms of the female half of the canula similar to the one indicated by *e*. This second thumb screw has lately been added to the female half of the instrument also. The thumb screw indicated by *e* in the male half of the device is used to secure a more rapid flow of blood by separating the arms of the hemicylinders and thus increasing the calibre of the vessel inclosed within them.* When the two hemicylinders of the male half are thus separated, they carry apart with them the hemicylinders of the female half, and when the device is in use with its hemicylinders thus separated, leakage does not occur.

If it is desired to use the instrument for making a permanent anastomosis between two segments of the same vessel or different vessels, such may be accomplished by merely suturing the two cuffs together over the supporting cylinders, as is illustrated in Fig. 2. This can be accomplished while the blood flows. After the suturing is complete the whole instrument may be removed by simply separating the two hemicylinders of each half of the instrument, and then the two halves from each other.

For the permanent suture of large vessels, different sizes of this device are desirable.

The students in the research laboratory have used this device for transfusion and for uniting vessels more easily than others at present in use.

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*I am indebted to Dr. John A. Hartwell for suggesting the addition of this screw.

# TRANSACTIONS
OF THE
# NEW YORK SURGICAL SOCIETY.

*Stated Meeting, held February* 8, 1911.

The President, Dr. Ellsworth Eliot, Jr., in the Chair.

## FIVE CASES OF FRACTURE OF THE FEMUR TREATED BY THE OPERATIVE METHOD.

Dr. John B. Walker showed these patients.

The first case was a woman, 26 years old, who slipped and fell, fracturing the neck of the femur. Two years after the occurrence of the accident she entered Bellevue Hospital. When standing, with the aid of crutches, the left lower extremity hung apparently helpless. The glutei and other muscles of the thigh on the affected side were moderately atrophied. There was 6 cm. shortening and a radiogram showed that the great trochanter was displaced far upwards. At the end of six weeks the continuous traction had diminished the shortening to 3 cm.

An operation was then undertaken to bring the separated fragments together and secure them in apposition. An incision was made, beginning 2 cm. below the left anterior superior spine, and extending downward and backward to the posterior margin of the trochanter, and then vertically down the thigh. The soft tissues were divided, then the capsule, exposing the fracture, which had occurred roughly transversely through the femoral neck, the proximal fragment consisting of the upper third of the femoral head. Considerable callus which was present was removed, and the fractured surfaces were freshened with the rongeur. By traction and abduction, and with great difficulty, the fragments were then brought into apposition.

A steel drill was passed through the great trochanter (the neck), the head, and into the wall of the acetabulum, thus spiking the fragments firmly together. The wound was closed, with a small rubber tissue drain, and a plaster spica was applied from

the lower border of the ribs to the toes. The wound healed uneventfully. The patient was confined to bed for eight weeks, and four weeks later a Thomas splint was applied and she went about on crutches, discontinuing the splint at the end of one year. Five months after the operation, the drill, which had become loosened, was easily removed.

Two years had elapsed since the operation. There was some motion at the hip, and less than 2 cm. of shortening existed. The patient walked without the aid of a cane, she was free from pain, and was able to support herself by doing regular work.

The second patient was a man, 40 years old, with a fracture through the middle third of the femur. When the dressings were removed, a month later, there was 4.5 cm. shortening, and only fibrous union had occurred.

Two weeks later, when Dr. Walker first saw the patient, the bone was exposed through an incision and considerable callus was present at the fractured ends. The fragments were freshened, and a quarter-inch intermedullary splint was inserted into the lower fragment; the upper fragment was then brought into alignment, and the splint pushed upward into the medullary canal for a distance of an inch and a half. The spica was removed six weeks later. Fifteen months after the operation, the patient was able to walk easily, without limping, and he had no pain.

The third patient was a boy, eleven years old, with an oblique fracture through the middle third of the femur with 3 cm. shortening, and a long side-splint and Buck's extension were at once applied. Ten days later the shortening still persisted, and the fragments could not be brought into alignment.

Fourteen days after the accident the seat of the fracture was exposed and the ends were found to be separated by a firm flap of periosteum, and they could be brought into correct apposition only after this flap had been excised. A steel plate was applied and secured by two screws inserted into the lower fragment. The shortening was overcome when the fragments were reduced. A plaster spica was applied and the patient was kept in bed for six weeks. Three months after the operation he was able to walk without limping or discomfort. Fourteen months had now elapsed since the operation and the steel plate had given him no trouble.

The fourth patient was a stout woman, 42 years old, with

a fracture through the upper third of the femur. Three hours after the accident she was brought to the hospital, and a long side-splint was applied. Three days later a radiograph was taken, which showed the usual deformity.

Six days after the accident Dr. Walker made a six-inch incision, exposing the seat of the fracture. The upper end of the lower fragment was found drawn inward and upward, while the lower end of the upper fragment was drawn upward and outward. There was a shortening of 4 cm. After considerable difficulty, and with very strong traction, the fragments were approximated. A large Lane plate was then applied, and fixed in position with six screws. The muscles and fascia were then united with fine catgut, and the skin with the finest subcuticular catgut suture. No drain was used. A plaster cast was applied from the pelvis to the toes.

Primary union resulted, and on the forty-second day the cast was removed. Six days later the patient was up in a chair and began to use crutches. Union was perfect, with less than 1 cm. shortening. Thirteen months after the operation the patient was able to walk without limping, and there had been no complication from the operation on account of the presence of the plate.

The fifth patient was a male, 16 months old, with a fracture of the upper third of the femur. When the infant was delivered by a midwife, the femur was fractured just below the lesser trochanter. No splint nor bandages were applied, and the fracture united with considerable angulation. The deformity had gradually increased, until there was about 2.5 cm. shortening.

Operation: A four-inch incision was made antero-externally. The femur was considerably thickened and increased in size, but no callus was present. The bone was sawn through, thus permitting it to be straightened and the divided ends to be accurately approximated. A small sized Lane plate was applied and held in position by four screws. The muscles and fascia were sutured with fine catgut, and the skin was united with a subcuticular catgut suture; no drain was used. A plaster cast was applied from the pelvis to the toes, and primary union resulted.

Ten days after the operation the plaster cast was removed and a new one applied. Thirty-five days after the operation, when the cast was removed, firm union was found to be present. The

patient was discharged from the hospital, and gradually began to walk, his gait becoming normal within six months. Fourteen months after the operation the child played with perfect freedom. There had been no complications.

In connection with this series of cases, Dr. Walker emphasized the fact that the operation should be done as soon after the injury as it could be determined that reposition was possible by no other method. It was better to clear out the clots at once than to wait for absorption, as it diminished the chance of sepsis. Traumatic reaction was going on all the time, so long as the bones were out of place, or so long as they were movable. The bone fragments injured the surrounding soft tissues, thus producing exudation and swelling. The longer the delay, the more the tissues contracted, and the chief difficulty in the reduction of fractures was the shortening of the tissues, which displaced the fragments.

Conclusions: The operative method was indicated: 1. For the immediate, accurate reduction of displaced fragments of long bones whenever it was impossible to correct the deformity without operation.

2. For the removal of soft parts between the fragments, which was the most frequent cause of non-union.

3. When properly performed with suitable instruments, it did not cause extensive laceration of tissue nor increase the risk of suppuration. It was absolutely necessary that an asepsis be observed which was far superior to that requisite for other operations, because a considerable quantity of metal was left in the wound. As these operations were usually very difficult, it was necessary that the surgeon and his assistants should acquire special skill.

4. It diminished the unfavorable results of conservative treatment. It simplified the usual treatment, for extension was seldom required and tight splinting was unnecessary. Physiological rest, so essential to rapid and uneventful healing, was frustrated by circular compression. It permitted earlier massage and passive motion, which was of so much importance in connection with joints in the earlier restoration of function.

5. It was *necessary* in fresh cases in which the fragments were irreducible or could not be moulded into place or kept in place after a fair trial, or in cases in which there was involve-

ment of the joints, with loose or unmanageable fragments, and in older cases of vicious union, with malposition of various kinds, which interfered with perfect function.

## BILATERAL PNEUMOCOCCUS MASTITIS.

Dr. John F. Erdmann presented a woman, 26 years old, whose last child was born five years ago. In October, 1910, she had an attack of pneumonia, and about a month later she developed an inflammation in the left breast. This was incised. Shortly afterwards, she noticed a small swelling in the right breast; this was excised, and upon examination proved to be an adenofibroma. A few days after the excision of this nodule, she developed a distinct inflammatory condition in the right breast, involving particularly the upper half of the gland. She consulted a prominent surgeon in this city, who pronounced it carcinoma. She then saw Dr. Erdmann, who suspected that the case might be one of pneumococcus mastitis, basing his opinion upon the preceding history of pneumonia, and a superficial patch of redness involving the breast. This diagnosis was verified by pathological examination, which showed pneumococci in pure culture.

The patient was operated on January 4, 1911, and was now entirely well. The changes in the breast proved to be purely inflammatory.

## BREAST CARCINOMA IN YOUNG WOMEN.

Dr. Ellsworth Eliot inquired at how early an age carcinoma of the breast had been observed by any of the members of the Society. Personally, he had never seen it earlier than the age of 25 or 26.

Dr. Erdmann recalled one typical example of carcinoma of the breast in a married woman, 21 years of age.

Dr. Charles H. Peck said he had had one case of carcinoma of the breast in a woman of 28, and that Dr. George E. Brewer had had one in a child of 11 years.

Dr. Frank S. Mathews said that in December last he had operated on a woman 25 years and 6 months old for recurrent carcinoma of the breast. The tumor had first been noted when she was 24 years and 3 months old. Her physician enucleated it through a small cut three months later; in three months more recurrence was noted. When Dr. Mathews operated, the axillary

nodes were not involved, but the growth, which had infiltrated the scar of the previous operation, was a typical carcinoma.

Dr. A. V. Moschcowitz said he had operated on a woman of 22 with a rapidly growing carcinoma of the breast.

Dr. Robert T. Morris said that recently, with Dr. Charles H. Walker, he saw a woman about 26 years old, who had a simultaneous involvement of both breasts. They were removed, together with the pectoral muscles and axillary glands. The operation was followed by a local recurrence in the neck and in the scar, and subsequently by further recurrences in the intercostal muscles and in the deep tissues of the neck. Shortly after the last operation the patient developed "pneumonia," which proved fatal. The pneumonia was regarded as the result of the malignant infection, the case apparently being one of rapidly developing general carcinomatosis.

## A STAB WOUND OF THE HEART.

Dr. Erdmann presented this patient. This case was already on record, a report of it having appeared in *The Medical Record*, December 17, 1910.

In reply to a question, Dr. Erdmann said that he drained this case because the stabbing had been done with a dirty fruit knife. The drain was carried into the pericardial cavity. There was a good deal of compression of the heart itself, but no effusion into the pleural cavity occurred.

## CARCINOMA OF THE STOMACH.

Dr. John F. Erdmann presented a woman, 60 years of age, who came to him with a history of carcinoma of the stomach and a palpable tumor in the epigastric region. She was admitted to the hospital on June 26, 1910, and on the following day Dr. Erdmann did a partial gastrectomy and pylorectomy. The patient's convalescence from the operation was uneventful; she was now able to eat practically everything, and had gained largely in weight.

The diagnosis in this case was adenocarcinoma, implanted, in all probability, on a previous ulcer.

## PYLORIC STENOSIS.

Dr. Erdmann presented a woman, 31 years old, the daughter of the preceding patient, who gave a history of gastric ulcer with pyloric stenosis. In this case he did a typical posterior gastro-

enterostomy, making no effort to excise the ulcer. The operation was done on November 18, 1910, and since then the patient had been free from symptoms, and her weight had increased from 95 to 109 pounds.

### PARTIAL GASTRECTOMY FOR CARCINOMA OF THE PYLORUS.

DR. ERDMANN showed a man, 48 years old, who gave a history of long-standing gastric disturbance, and examination revealed a slightly movable mass in the epigastric region. At the time of the operation, which was done on December 10, 1910, the man was in very poor condition. His weight was 129 pounds, and his hæmoglobin was reduced to 62 per cent. A partial gastrectomy and pylorectomy was done, over four-fifths of the stomach being removed. On January 25, 1911, the man's weight had increased to 137½ pounds.

### SIX ABDOMINAL SECTIONS IN ONE PATIENT.

DR. ERDMANN presented a man 52 years old, who had never been ill until January, 1897, when he had a well-defined attack of appendicitis lasting about four days, after which he felt quite well. About a month later he had another attack very similar to the first, which lasted about the same time, and again he felt about as well as usual. On March 12, about a month after the second attack, there was a recurrence of his symptoms, and on the 18th he went to Dr. Keen's private hospital in Philadelphia, as he was now able to feel a distinct mass in the region of the appendix. On March 27, as his symptoms did not abate, Dr. Keen operated, opening and draining an appendiceal abscess; the appendix itself was not seen. Three days later, an abscess developed on the left side, which was opened and drained. A few days after this, a large fecal fistula developed in the first wound, which was operated on but without success. At this time, Dr. Keen said the patient had universal peritonitis. The right fecal fistula closed in December, 1897.

In June, 1897, a fecal fistula developed in the scar on the left side, which persisted several months. For about a year after these various operations, the patient felt a distinct dragging pain after emptying the bladder, which he attributed to an adhesion to the bladder. This symptom then disappeared, and

he thought nothing more about it until about seven years after the operations, when, one morning, upon urinating, a foreign body was expelled through the urethra, and upon investigation he found a calculus that had for its nucleus a silken knot, which must have come from the site of one of the previous operations.

Subsequent to this, with the exception of the slight annoyance caused by an incisional hernia on the right side, the patient was well until March, 1910, when he had an attack of questionable typhoid fever, lasting six weeks. On May 28, 1910, his hernia became strangulated and was operated on by Dr. Robert T. Morris.

On August 26, 1910, during Dr. Morris's absence from the city, he complained of symptoms which led to the belief that he had an abscess of the liver. Three days later Dr. Erdmann operated, and found a very badly matted in gall-bladder filled with pus; this was emptied, and the patient was put to bed. Subsequent to this he passed clay-colored stools, and showed evidences of pancreatic invasion. He returned to his home in Pennsylvania for a time, and when he returned, in October, 1910, his symptoms indicated an obstruction to the common bile-duct.

On October 22, Dr. Erdmann again opened the abdomen, doing a transduodenal operation and removing a stone from the duct. After this operation, the patient was in profound shock for 22 hours. His convalescence otherwise was very stormy, but he finally recovered entirely, and was now enjoying perfect health. His present weight was 190 pounds, a gain of 40 pounds since November 9, 1910.

Dr. Mathews said he once contributed one to a dozen abdominal sections on the same patient. The early operations had been done in Spain for appendicitis, tuberculous peritonitis and Cæsarean section, and the later operations were for intestinal obstruction, the result of ubiquitous adhesions.

Dr. Erdmann said that speaking of operations from the numerical stand-point, he recalled the case of a widow upon whom he recently did the tenth. Some 4 others had done the other nine.

# TRANSACTIONS
OF THE
# PHILADELPHIA ACADEMY OF SURGERY.

*Stated Meeting, January 16, 1911.*

The President, Dr. R. G. Le Conte, in the Chair.

## RECENT ADVANCES IN PULMONARY SURGERY.

Dr. John H. Jopson delivered the annual oration before the Academy upon the above theme, for which see page 593.

Dr. Henry R. Wharton said that most of the cases of lung injury which he had treated had been by the conservative method. He had seen a large number of very serious injuries of the lung recover. The majority of these cases were injuries of the chest from the pas age over it of heavy wagons; at the Children's Hospital there were formerly a great many such cases, and although some of them died, quite a number of those even sustaining a rupture of the lung finally recovered. In adults he did not believe that the statistics of rupture of the lung complicated with fracture of the ribs are quite so favorable as in children. The last case under his care was an Italian boy at the Presbyterian Hospital, who had fracture of the ribs on each side, with laceration of the left lung, hæmothorax, pneumothorax, and extensive emphysema. Aspiration was done a number of times; this boy was desperately ill; finally a rib was resected so as to drain his chest on the left side where the rupture of the lung had occurred, and he recovered.

With regard to gunshot wounds of the lung, the majority of his cases had been treated on the expectant plan and had done well. The case to which the reader of the paper referred was that of a stab wound of the lung, which was aspirated several times on account of pneumothorax and hemorrhage; finally there was a resection of a rib for an empyema, with recovery.

## SACRO-ILIAC ARTHRITIS FOLLOWING TYPHOID FEVER.

Dr. Walter G. Elmer reported a case which he believed presented certain features of interest, more especially in regard to the diagnosis. He also thought the lesion to be a rare one.

A young girl, nineteen years of age, was admitted to the surgical ward of the Presbyterian Hospital in the service of Dr. Oscar H. Allis on June 2, 1910.

During the preceding February and March she was quite ill with typhoid fever and was in bed for eight weeks. During her convalescence, about the middle of March, she developed swelling with severe pain of her right lower limb from hip to ankle. This swelling persisted for about six weeks, or until the first of May, when it subsided and all the pain became centred in the region of the right hip and back. Pain was worse at night, of a dull boring character, and patient had night-sweats.

On admission to the hospital, June 2, the temperature was 100°, pulse 112. After the first two days the temperature rarely rose above the normal and then only a fraction of a degree. At times the pulse was rapid. The patient complained of a good deal of pain in the back and right hip.

A physical examination of the heart and lungs revealed nothing abnormal. The kidneys were not unduly movable. The patient preferred to lie turned partly to the left side with the right limb slightly flexed.

At times the patient was seized with sudden, intense, agonizing pain, so great that she would give piercing cries, and then, making a brave effort at self-control, would lie moaning, her hands gripping the sides of her pelvis, tears running down her face, her whole body trembling and held rigidly in a fixed position apparently unable to move, and dripping with sweat. If any one approached her bed she begged that she should not be touched. The intense suffering was very real and it was quite pitiful to witness. There was no element of hysteria about it.

These attacks would sometimes come on at night, when the girl's cries would awaken and alarm the other patients in the ward. Hypodermic injections of morphia were necessary to give relief—sometimes two being required before the patient could relax. She would then suffer a good deal of pain for perhaps a day, it would finally disappear, and perhaps for days she would be quite comfortable. Then without any warning she would be seized with another attack of intense pain.

Pressure over the sacrum and right innominate bone revealed tenderness, and also if the patient made any pronounced voluntary movement, even though lying in bed, she had pain. Manipulation of the right limb showed that the muscles of the

lumbar spine and right hip were on guard and resisted movement. Side pressure upon the innominate bone caused pain in the lumbar region.

The lower limbs were equal in length. No abnormal mobility of the pelvic bones could be demonstrated. The urine showed a very faint trace of albumin, but was otherwise always normal and never showed any evidence of the presence of a renal calculus. The leucocytes ranged between 7550 and 7800. A differential count of the leucocytes showed nothing unusual. The hæmoglobin was 77 per cent. An X-ray plate of the lumbar spine and pelvis gave no assistance.

The patient had been placed upon a rather firm bed with fracture boards beneath the mattress; a folded sheet was placed under the hollow of her spine, and with this in position she could lie on her back with considerable comfort.

The speaker happened to enter the ward one day when she was in intense pain in the midst of one of her attacks. He turned her carefully on her back with the support under her lumbar spine, and slowly and forcibly flexed her thigh up to the full limit on her trunk. The movement gave her great pain. She cried out and was wet with sweat. Pretty firm pressure at the full limit of flexion, however, gave her relief from pain, and he was able then to slowly lower the limb until it rested on the bed beside the other one and the patient was relaxed and the suffering almost entirely relieved.

The indications for treatment were rest in bed for an indefinite period and nourishing food. The advisability of applying a fixation dressing was considered, but it was concluded to allow her to assume any position in bed which gave her the greatest comfort until the disease should run its course.

The patient continued to have attacks of pain at intervals of several days or a week. They grew less frequent, however, and less severe.

On August 7, a plaster jacket was applied, and the patient allowed to get up. She was discharged on September 5 still wearing the jacket. Two months later she had regained her normal weight, had a good color, and was in perfect health. Her plaster jacket had been discarded a month previously. She could go up and down stairs, stoop over and rise again, walk long distances, all without inconvenience, and had no symptoms whatever.

Here was a patient who, long after the acute symptoms of typhoid fever had subsided, suffered from excruciating attacks of pain, as agonizing in character as that caused by the passage of a gall-stone through the common duct or a renal calculus through a ureter.

The explanation of these attacks seems to be clear. The phlebitis of the right limb was in all probability a direct result of the typhoid fever infection, and it in turn resulted in an infection of the right sacro-iliac joint. The joint surfaces became exquisitely tender and sensitive to abnormal pressure. The ligaments of the joint had become relaxed as a result of the long illness which the patient had suffered, permitting an undue mobility in the joint. The acute arthritis caused the dull aching pain in the sacrum and lumbar region and hip and thigh.

During sleep, when the muscles were somewhat relaxed, and the patient perhaps turned in bed, the joint surfaces slipped slightly on each other, bringing pressure on acutely inflamed areas which had not been bearing it—then the intense pain, the waking of the patient, the sudden gripping of the muscles upon the bones as the reflex spasm returned with the added pain of the increased pressure, and the patient's body becoming rigid from the paroxysm of pain. If the joint surfaces could be restored to their normal apposition the pain promptly grew less, as was demonstrated on one occasion.

In due time the infection ran its course, the tender surfaces returned to their normal condition, the structures about the joint regained their normal tone, and the patient's recovery was complete.

THE SURGICAL ANATOMY OF THE PARATHYROID GLANDS AND ALLIED LYMPH-NODES.

Dr. Nate Ginsburg read a paper with this title.

REMOVAL OF THE URETER WITH A TUBERCULOUS KIDNEY.

Dr. George Erety Shoemaker read a paper with this title, for which see page 696.

Dr. John B. Shober said that three years ago he removed a large tubercular kidney with a very much thickened ureter from a patient who had a persistent sinus following a psoas abscess opened five years before. Tuberculosis of the kidney, in his opinion, is a secondary process in the vast majority of cases, and the primary focus should be sought for and reported

more often than it is. This patient was operated upon in a similar manner to that described by Dr. Shoemaker, although the incision was more perpendicular, beginning at the costal cartilages at about the tip of the eleventh rib and following a line obliquely down about one inch inside Poupart's ligament. The peritoneum was reflected from the lateral and posterior walls, the kidney and ureter were located and removed with ease; the ureter was followed down to the broad ligament, then to the bladder, and then ligated as one ligates an appendix from the cæcum. It was quite easy to almost purse-string the stump of the ureter after it was ligated close to the bladder. This case was reported somewhat in detail before the Obstetrical Society of Philadelphia, in Feb., 1908, and published in the *Therapeutic Gazette,* June 6, 1908. The subsequent history is interesting.

About a month or two after the patient was operated upon, she developed symptoms suggesting a tuberculous pelvic peritonitis involving the Fallopian tubes.

Operation showed this was not the case, but there was a fibrous uterus with chronic inflammation of the tubes, necessitating hysterectomy. At the same time the appendix was removed. She made an uneventful recovery. At neither operation was the speaker able to follow the sinus which led to the vertebral column. It continued to discharge for a year or more. In the meantime patient had gained about 45 pounds. In order to cure the sinus he injected bismuth paste successfully. After injecting the bismuth vaseline paste he took an X-ray picture and found that the sinus led by a rather straight route to one of the lumbar vertebræ, ending in a bulb, which extended across the vertebræ to the opposite side.

It required ten injections of the paste to close the sinus permanently. However, about eighteen months ago another psoas abscess developed on the opposite side. This was promptly opened and treated by a few injections of the bismuth-vaseline paste, after which it closed permanently.

Dr. George G. Ross reported the case of a woman who had been suffering for six or seven years from a painful swelling in the right side of the abdomen. At the German Hospital, upon exposure it was found that she had a perinephric collection, which when opened, showed a collection within the kidney itself

and a large tuberculous ureter. The entire mass was adherent to the diaphragm, the posterior abdominal wall, and to the peritoneum in front. Recognizing his surgical limitations, he left the kidney in. She did very well for a while, draining urine and pus through the opening in the loin; the sinus healed and finally she got into such good condition that she started for home. She got as far as Baltimore, when the sinus broke out again; she returned immediately to the hospital and he again operated with the hope that the kidney had gone down to a size possible to remove. On exploration, however, he found practically the same condition as at the first operation. The kidney was smaller but still too large and adherent to remove. The sinus was dissected out and the kidney wound sewed up; patient had repeated ureteral catheterizations with washing out of the pelvis of the kidney. This was three years ago. She has now a perfectly functionating organ without sinus, pus, or discomfort. She has, however, a bad hernia.

Dr. John H. Gibbon thought that tuberculosis of the urinary tract usually starts in the kidney. Very often there is no evidence of inflammation of the kidney, nothing to indicate which is the kidney pouring the pus into the bladder, but the cystoscopic examination clears up the situation. If there is a tuberculous kidney there will not be a normal ureteral opening in the bladder. Occasionally we will have difficulty in making a cystoscopic examination. He encountered such difficulty some years ago in the case of a physician who had so much pus and blood in the bladder that he was unable to see the ureters. He did a suprapubic drainage of the bladder and examined it through a speculum and found extensive ulceration around the right ureter and around the base of the bladder but could not tell whether or not this involved the left ureter. He therefore followed Freeman's suggestion, that in order to make sure there was a normal kidney on the unsuspected side this kidney should first be exposed. Therefore, at a second operation he exposed the left kidney and found it to be perfectly normal. He then removed the right kidney but did not remove the ureter, and the abatement of symptoms was very prompt; before operation the patient voided urine every two hours at night and every half hour during the day, and before leaving the hospital, within two or three weeks, did not empty his bladder at all during the night.

The significant point here is that after the removal of a kidney which had been pouring pus into a bladder filled with ulcers, this bladder condition clears up. This seems to show that it is not necessary to remove the ureter unless it be very badly involved. The speaker said he had not taken out the ureter in tuberculous kidneys, nor sterilized it, but nevertheless the results had been good. If an ulcerated bladder will clear up after removal of a tuberculous kidney, the ureter also will do so provided we remove it as far down as possible. He had seen Mayo inject pure carbolic acid into the remaining portion of the ureter for sterilization. He said he had done it a great many times and had had no bad results. His feeling was that this might very easily cause a stricture of one part of the ureter and make trouble, but he had had no such trouble.

Dr. George Erety Shoemaker (in closing) said that in the diagnosis of these lesions the intramuscular injection of a color solution has a great advantage over the use of the catheter. He felt quite a little hesitancy in putting a catheter through an unsound field into what may be a sound field. If one will take the time to watch and count the spurts of colored urine, it is usually easy to recognize the kidney which is actively at work and compare it with one which is doing very little or nothing. So many accidental variations, such as clogging by minute clot or detritus, mechanical variations in calibre of the lumen, reflex inhibition, etc., affect the outflow that estimation of relative activity by the catheter is not reliable. Some tubercular ureters if not removed create a sinus, but fortunately most do not require removal.

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